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REPORT ON NORTHERN PLAINS BRANCH

Lake States Forest Experiment Station

By

J. H. Stoeckeler

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Chart showing status of experimental planting at Northern Plains Branch Station, Denbigh, N. D. as of April 1, 1942

Charts showing Denbigh plantation status as of April 1, 1942 as follows:

- E½ of NW of NW, Sec. 36
- NE of NW, Sec. 36
- SW of NW, Sec. 36
- NW of SW of Sec. 36
- NE of SW of Sec. 36
- SW of SW of Sec. 36
- SE of SW of Sec. 36
- NW of SE of Sec. 36

Tables showing Denbigh plantation status as of April 1, 1942 as follows:

- NW of NW and NE of NW, of Sec. 36
- SW of NW of Sec. 36
- NW of SW of Sec. 36
- NE of SW of Sec. 36
- W½ SW of NW of Sec. 36
- E½ SW SW of Sec. 36
- SE of SW of Sec. 36
- NW of SE of Sec. 36

Average temperatures, 1941

Soil temperatures at depth of four feet

Wind movement at station No. 1

Monthly wind movement

Grams of evaporation from Bates evaporimeter - Type 6

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INTRODUCTION

This report incorporates results of planting and nursery experiments conducted largely at Towner and Denbigh, North Dakota. Some experimental work was also started in the spring of 1941 when 100 4'x4' beds were sown at Oakes Nursery, Oakes, North Dakota, to solve specific nursery problems.

In previous reports a detailed description of the McHenry County sandhill areas is given and comparison and contrast made with the Nebraska National Forest.

Results of planting at Denbigh indicate that the Denbigh area differs radically from the Nebraska sandhills in several respects, first, that for the dominant soil type the broadleaf species fare better than conifers at Denbigh and that careful ground preparation and cultivation are necessary which in intensity surpass standards required on the Shelterbelt Project.

1/ The writer wishes to acknowledge the work of Mr. Donald Manning, who did much of the field work at Denbigh and Towner; credit is also due to Messrs. Paul Roberts, F. E. Cobb, and O. M. Patten for their help in furnishing equipment and aid in installation of the experiments.

Cultivation technique has been carried to such an extreme that it is now recommended that all plantings of broadleaf species have a row alignment that permits cultivation to be done both lengthwise and crosswise of the tree rows. How this would work out with pine conifer plantings is not known but it is surmised that they would have to be planted in the protection of one- to five-row belts of cottonwoods spaced at intervals of 100 to 300 feet. The closer spacing would probably be necessary on areas where conifers were planted at the same time as the cottonwood strips. Spacings of 200 to 300 feet between cottonwood strips could be used where they were planted some 5 to 10 years before filling in the intervening gaps with conifers such as ponderosa pine or juniper. The only other alternative would be planting of 1 or 2 rows of Chinese elm for every 5 to 10 rows of ponderosa pine. We have plantations now which combine alternate row mixtures but these are too young to indicate whether the plan is feasible on a large scale.

The necessity of complete removal of competing weeds and grass has been so clearly demonstrated that in the period August 25 to September 3 approximately 140 acres of plantation, which were formerly either 3-foot hester furrows or 4- to 5-foot-wide cultivated strips, were plowed with a Moline disk plow to remove the sod strips between tree rows which varied from 3 to 5 feet in width.

Besides the heavy emphasis on cultivation and plantation care, the main effort in 1941 at Denbigh Station was devoted to improving the appearance of the station and the grounds. This was accomplished by continued mowing of the natural sod lawn, planting additional ornamental groups, irrigation and fertilization of ornamentals, ripping sod out between arboretum and windbreak rows, keeping hedges trimmed, converting the old nursery site north of the residence to an arboretum. Contrast in appearance of the station can be judged by Figures 1 to 3.

PLANS FOR THE FUTURE

Because of past and probable future curtailment of funds and the transfer of Manning in October 1941 to the Dukes Branch Station, emphasis in the future at Denbigh will be directed toward cultivation of existing plantations until a closed canopy is formed in hardwoods and until conifers average 3 feet in height. The other minor jobs will include cultivation and watering of arboretum and ornamentals, general upkeep of station grounds, cultivation of windbreaks, and a small amount of replanting of failed spots in arboretum or completion of unplanted blocks. It is also planned to plant a snow trap on a 65 by 2000 foot strip to the west of the road leading from U. S. Highway 2 south to the northwest corner of Denbigh Station property. This area was plowed up

Figure 1.--Headquarters building at Denbigh on August 31, 1935

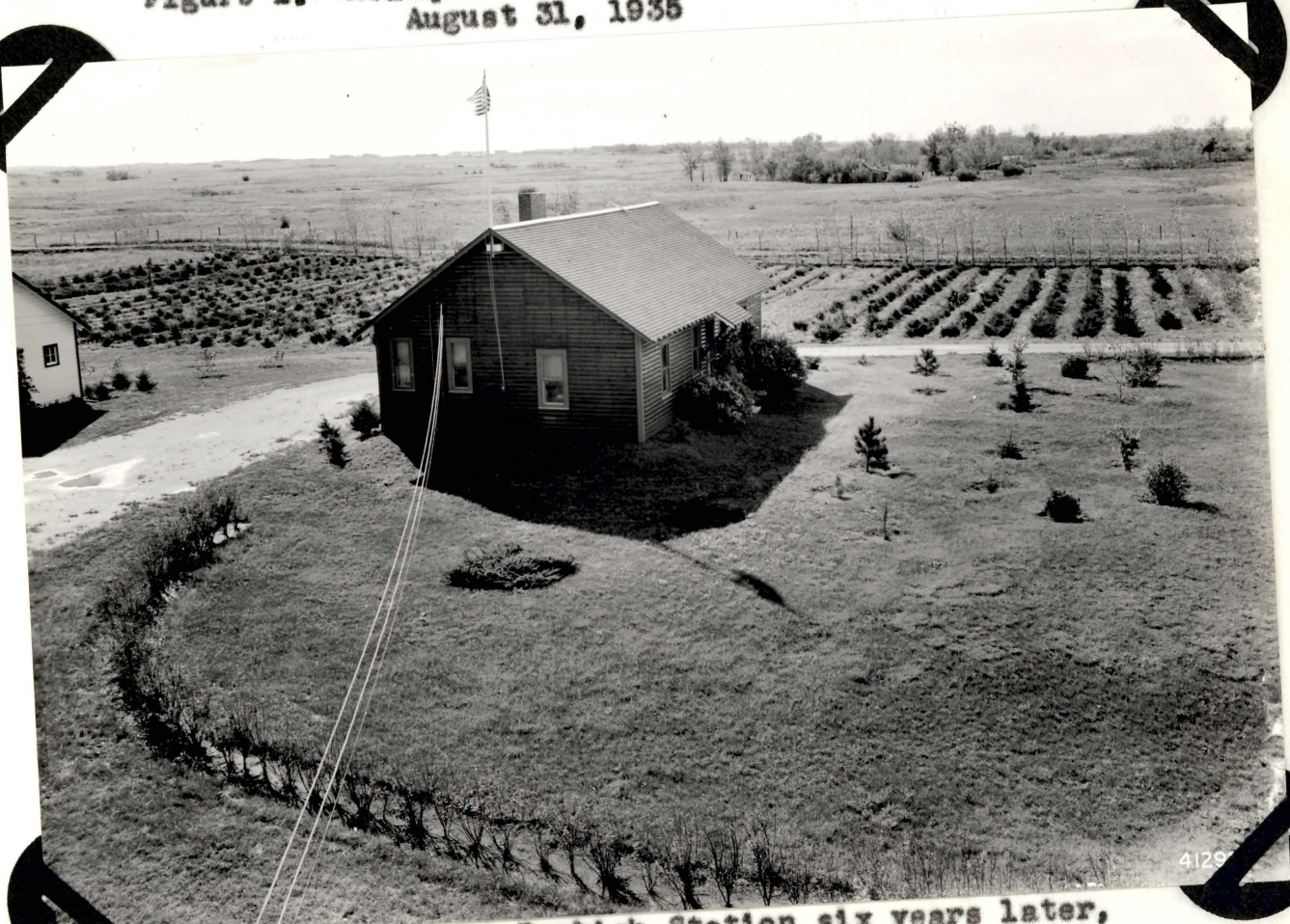


Figure 2.--Headquarters at Denbigh Station six years later, on September 15, 1941

Figure 3.--View of Denbigh Station on September 6, 1941. Ornamentals include Siberian pea, Rocky Mountain juniper, honeysuckle, green ash, American elm, dogwood tamarix, lilac, Russian olive, ponderosa pine, Scotch pine, red haw, Colorado blue spruce, and dwarf juniper.

and disked in summer of 1941 and a 6- or 7-row windbreak is planned for the area. Tentative cross section from west to east is Russian olive, green ash, 2 rows boxelder, green ash, ponderosa pine, and red cedar.

The shortage of W.P.A. labor at Granville and Denbigh, the two areas from which we have obtained labor in the past, is expected to be so acute that we will probably have only 1 or 2 W.P.A. men in the spring in addition to our resident caretaker, Mr. Harold Stewart.

No new field planting is contemplated but it is suggested that the following replanting be done in order to save the 3 lots of valuable nursery stock now at Towner Nursery. All are to be planted in the remnant of failed white elm, Plantation 51 in NE of SW in rows 86 to 91 as shown below.

Seed-bed no.	Age class and species	Collection or serial no.	Seed source	Approx. no. in nursery	Rows in which to plant in P-51	Space between trees in row of 1200 ft.	Approximate number to plant
1/1648	1-0 black locust	ST4111	Idaho	1200	86 and 87	5	800
1/1649	1-0 black locust	C-501	East Tawas, Mich.	800	88 and 89	5	800
1449	1-0 Fraxinus mandshurica		U.S.S.R.	720	90 and 91	4	600

1/ The two lots of black locust are side by side at Towner Nursery in 4'x50' beds. The Idaho source is in the north bed; the East Tawas source is in the south bed. The Manchurian ash is about 250 ft. straight west of bed #1649 at Towner Nursery.

In addition to the cultivation work, one other important task is to keep systematic pressure on the rabbit population within a mile of the station by rabbit drives or individual hunting. Probably arrangements can be made with the Shelterbelt Project to stage 1 or 2 drives a year as they did in late 1941.

The rainfall records should be continued and also the well measurements from April 1 to December 1. No other weather records are planned for the future.

PRESENT CONCEPT OF THE PLANTING AND CULTIVATION PROBLEM AT DENBIGH

It can be said with confidence that real progress has been made at Denbigh in the last two years, especially in the matter of ground preparation and plantation care.

There has been little change in choice of species and cottonwood, green ash, ponderosa pine, and Rocky Mountain red cedar constitute the only species which warrant planting in fairly extensive blocks. Eastern red cedar may also have a place in the list.

The results of cross cultivation of cottonwood have been outstanding. In the summer of 1940 seven strips of native sod ground 1320 by 50 feet were plowed up with a breaker plow and were planted on a forty-acre tract in spring 1941 with 5 rows of cottonwood on each strip and an interval of 100, 150, or 200 feet between tree strips. All trees were

spaced 9 by 9 feet and cross checked so as to get alignment of tree rows in 2 directions and thus facilitate cultivation. A map of the 40-acre tract on the scale of 1 inch to 660 feet is given in the appendix of this report. The area is on smooth-lying Valentine fine sand. Not over 5 percent of it is Gannett fine sandy loam.

The original purpose of this planting was to test the use of narrow cottonwood tree belts to act as a protective buffer for conifers to be planted on the intervening 100 to 200 foot-wide strips after the cottonwood was about 5 to 10 years old. That would be about 1945 or 1950. Whether the plan can be carried through to completion will depend largely on future finances and station policies laid down at St. Paul.

During 1940 the seven cottonwood strips were cultivated 6 times in the long direction of the rows and cross disked on 2 occasions with a 6½-foot disk pulled by our Allis Chalmers tractor or by the Towner Nursery's "Farmall" tractor.

In 1941 the 7 strips were cultivated lengthwise 3 times and crosswise twice with the first cultivation given May 9 to 13. No hand work was done on any of the plantations. The survival and height data at the end of the first and second year are given in table 1 and 3 photographs are given in figures 4, 5, and 6.

Table 1.--Survival and height in cross-cultivated cottonwood at Denbigh, N. Dak.

Plantation no.	Age class	Seed source	Nursery	No. trees planted	Survival: First year	Survival: Second year	Height: First year	Height: Second year
		(N.Dak.)	(N.Dak.)				Inches	Inches
60	1-1	Bismarck	Towner[1]	775	81.2	75.7	30	61
61	1-1	Bismarck	Towner[1]	770	79.6	74.6	31	63
Average					80.4	75.1	30	62
62	1-0	Mandan	Mandan	790	94.6	94.8	38	76
63	1-0	Mandan	Mandan	780	97.0	95.7	38	87
64	1-0	Mandan	Mandan	760	97.4	95.3	38	72
65	1-0	Mandan	Mandan	745	95.7	92.0	38	92
66	1-0	Mandan	Mandan	770	92.9	92.2	38	78
Average					95.1	94.0	38	81

1/ These were 1-year-old wildings lined out in the nursery for an additional year.

Figure 4.--Aerial view from over the "natural" forty (in foreground at right) looking toward the NW of SE planted to seven ¼-mile long 5-row cottonwood strips in spring 1940. Photo 8-23-41. Double line at right is a fire line. Denbigh, N. Dak.

Figure 5.--View of 2-year-old cottonwood in fifth strip from the left in the above aerial photograph.

Figure 6.--Closeup of vigorous 2-year-old cottonwood plantation at Denbigh, N. Dak. Note freedom from weeds because of cross cultivation. Aug. 7, 1941. Plantation 63.

It is seen that survivals and growth are fairly good for the 1-1 stock and exceptionally good for 1-0 nursery grown stock. It seems certain that there will be required some additional cultivation to bring the plantations of cottonwood through to success. It is believed that 3 cultivations should be sufficient the third year and 2 cultivations the fourth year.

Cost data kept on operation of the Allis Chalmers tractor at Denbigh Station show a cost of about 6½ cents per acre per cultivation for gasoline and oil. A spacing of 9 x 9 represents about 1.3 miles of row per acre and since the tractor can average at least 2 miles per hour, it is estimated that labor costs for tractor operator will be 40 cents per acre. Allowing for gasoline, oil, depreciation and repair, total costs per acre per cultivation will be about 50 cents or not over $3.00 per acre per year.

If cottonwood were grown on a large scale in the Denbigh area, the natural tendency to get maximum efficiency would be to use blocks of such a size that the minimum length of row would be ¼ mile so as to reduce the amount of time lost on turn rows. This would cut costs considerably below those available from the present 5-row belts we now have at Denbigh. Also a mechanized system of cross marking plantations and of the planting would of necessity be adopted.

Cross marking could be done with a large sled device which would make 3 to 4 shallow furrows simultaneously on land plowed under in summer of the previous year. Space between furrows would be 9 to 10 feet. Marking would proceed until an entire forty-acre block had been marked and the planting machine developed by the P.S.F.P. used in planting tree rows at right angles to the furrow marks. The planters would merely use the marks as a guide in spacing their trees so as to get reasonably good two-directional alignment of the tree rows to allow for cross-cultivation.

It is believed that successful plantations of cottonwood could be established on a large scale for a total cost of $20 to $25 per acre including ground preparation, marking, planting stock, cost of planting, and 4 years of cultivation.

The efficiency of the work would probably hinge on a maximum of mechanization for all operations so as to eliminate hand work almost entirely.

PLANTATION RENOVATION ON 140 ACRES IN 1941

Because of the clear-cut case for complete removal of competing vegetation in young cottonwood plantations, it was decided in the summer of 1941 to work over practically all of the plantations at Denbigh with a heavy Moline disk plow to remove the 2- to 5-foot wide strip of sod which is left between

tree rows in areas prepared originally either with a Hester fire-line plow or by the strip method of plowing (5-foot width) used in some areas notably the NE of SW at Denbigh Station.

Figure 7 illustrates the appearance of a plantation with sod strips between the tree rows. It also shows the problem encountered when the trees become so large that they are subject to injury when the tractor straddles the tree row. The sodded strips were left for fear of wholesale soil blowing which might occur after several years of cultivation. Subsequent experience has indicated that at least for cottonwood, the growth rate is so rapid that by the time the surface soil loses its power to resist wind erosion because of destruction of its root-laden cloddy condition, the trees will have formed a closed canopy and a forest condition.

To apply principles learned in 1940 and 1941, about 140 acres of plantation were disked between August 25 and September 3, 1941 in a manner shown in figures 8 to 10. A 5-foot Moline disk plow pulled by a "40" caterpillar tractor was run down the sod rows and then was disked with a tandem disk to smooth up the job and chop up the large ribbons of sod. In 1942 it will be necessary to use a disk on these areas because a shovel cultivator would tend to get plugged up with clods of sod. In 1943 and thereafter until cultivation ceases, a shovel cultivator can be used if it proves to be more feasible than disking.

Figure 7.--Allis Chalmers (Model B) tractor cultivation of cottonwood planted on 5-foot-wide plowed strip.

Figure 8.--Plantation #50 at Denbigh. Cottonwood planted in 1935. Replanted in 1938. Photo 9-1-41 just before disking.

Figure 9.--Same as Figure 8 but after being disked.

Figure 10.--Looking about east-south-east, from windmill tower, toward Denbigh plantations of cottonwood and Chinese elm after complete removal of sod by disking with Moline one-way disk. Sept. 14, 1941. Note natural aspen clumps in distance.

Figure 10-A. Looking north from southeast corner of P-24B, which is ponderosa pine planted in 1936 and 1937, in a 4-foot wide Hester furrow; in fall 1941 the sod was ripped between tree rows with a one-way disk plow. Photo in fall 1941.

Out of a total of 290 acres planted to date at Denbigh Station the areas are here broken down into several categories which show class of cultivation and ground preparation.

	Acres
(1) Scalps in dune areas not feasible for the most part for mechanical cultivation (SW of SW)	40
(2) Renovated with disk plow in fall 1941. (Approximate. The actual net area is about 133 acres.)	140
(3) Plantings on 15- to 30-foot-wide plowed strips (E½ of W½ SE SW and all of E½ SE SW). Strips contain either 2 or 4 rows.	30
(4) Cross-cultivated 5-row cottonwood strips. (Seven of these planted in NW of SE with 30 acres of sod between tree strips. A total of 8.75 row miles of trees.)	10
(5) Uncultivated plantations in 12-inch furrows which will be abandoned, saving a few for demonstration value and plowing up the rest because of low survival and poor growth.	70
Total 1/	290

1/This total of 290 net acres of plantation does not include some 4.4 acres of uncultivated 12-inch furrows planted in spring 1931 by Rudolf in the NE of NE of the station section.

The areas which were disked in the fall of 1941 for the purpose of removing the sod strips are listed below.

	Number of rows disked
(1) E½ NW NW. All except P-12.	105
(2) W½ SW NW. All except P-9 and P-10B. P-9 has 8 rows of juniper in 12-inch furrows planted in 1932. P-10B has 30 rows of juniper on 5-foot plowed strips and in 11 rows (80-90) were cultivated and hand hoed in 1940 and 1941. Rows 91 to 109 received only tractor cultivation and no hand hoeing in 1940 and 1941.	102
(3) E½ SW NW. Except P-1, P-5, P-5A, P-5B	61
(4) W½ NW SW. Except P-26A	112
(5) E½ NW SW. Except P-24C, P-24D, P-24E	151
(6) NE SW	247
(7) W½ SE SW	34
(8) W½ NE NW. Plowed up sod only P-16A. Rest of area is in 12-inch furrows.	7
(9) E½ NE NW. Plowed up sod only P-18 and P-19A. Rest of area is in 12-inch furrows.	26
Total	845 rows

Note: All rows are 1/8 mile long except items 3, 6, and 7, which are 1/4 mile long. Total amounts to 141 row miles.

The present status of ground preparation and cultivation for Denbigh plantations is shown in figure 11. This particular map should be used by the man doing cultivation in the field.

SOIL MOISTURE STUDIES IN 1941

The 3 moisture sampling points used in 1940 were kept under observation in 1941 and samples were taken 5 times during the season. These sampling areas are designated as (1) unbroken sod, (2) cultivated Hester furrow of 4-foot width, and (3) cross-cultivated cottonwood. Samplings made in 1940 showed available moisture to be 1.98, 3.20, and 4.30 percent respectively for the 3 stations for 8 samplings made between August 21, 1940 and October 17, 1940.1/

The 1941 samplings also included one station not used before - namely, a dune sampling station designated as I and is located on a dune which lies about 25 feet above the level of the surrounding Valentine flats.2/ It is more typical of true dune sand conditions than Station C used in 1936, 1937, and 1938, referred to in the 1935-1938 report for Denbigh Station. The planting here was done in 12 x 12" scalps and no other soil preparation or cultivation was done since the trees were planted.

1/ From table 4 of 1939-1940 Denbigh report. Sample areas were called S, H, and A, respectively, and exact locations are given in the table.

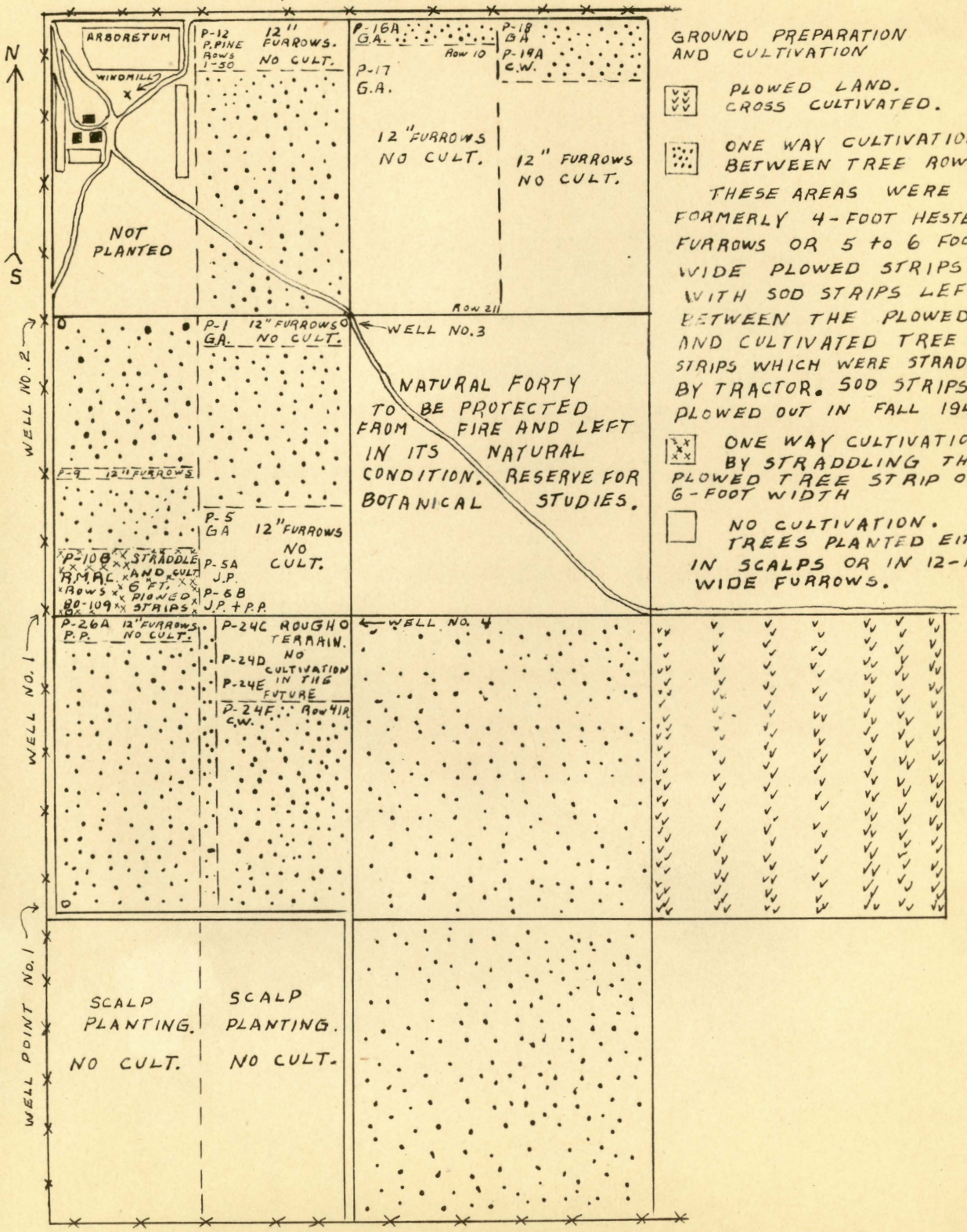
2/ Station I is about 50 feet from west end of tree rows numbered 133 and 134 in W½ SW SW.

Figure 11

STATUS OF EXPERIMENTAL PLANTATION GROUND PREPARATION AND CULTIVATION AT DENBIGH STATION AS OF APRIL 1, 1942.

NORTH DAKOTA

SEC 36, T156 N, R.78 W.



GROUND PREPARATION AND CULTIVATION

PLOWED LAND. CROSS CULTIVATED.

ONE WAY CULTIVATION BETWEEN TREE ROWS. THESE AREAS WERE FORMERLY 4-FOOT HESTER FURROWS OR 5 to 6 FOOT WIDE PLOWED STRIPS WITH SOD STRIPS LEFT BETWEEN THE PLOWED AND CULTIVATED TREE STRIPS WHICH WERE STRADDLED BY TRACTOR. SOD STRIPS PLOWED OUT IN FALL 1941.

ONE WAY CULTIVATION BY STRADDLING THE PLOWED TREE STRIP OF 6-FOOT WIDTH

NO CULTIVATION. TREES PLANTED EITHER IN SCALPS OR IN 12-INCH WIDE FURROWS.

The data for the 1941 samplings are given in table 2 and summarized in table 3. The grand averages given in table 3 indicate that cross-cultivation gave the highest average available moisture percent (although the margin this year was not as great nor as consistent as in 1940) with maximum differences showing up in July before the heavy fall rains set in.

SOIL SURFACE TEMPERATURES IN FIELD PLANTING AREAS

On July 22, 1942 on a warm, clear, cloudless day, soil temperature data was obtained at approximately half-hour intervals on several types of areas near Denbigh, N. Dak. to tie the data into various ecological and planting problems.

One of the most interesting ecological features of large dunes in the McHenry County sand hill area is the heavy cover of brush and tree growth on northeast slopes and practically barren southwest slopes. The northeast slopes are covered with a dense tangle of chokecherry, juneberry, red haw, hackberry, boxelder, American elm, and burr oak. The southwest slopes have a thin ground cover of blowout grass (Redfieldia flexuosa) and other grass with an occasional chokecherry shrub or burr oak tree.

Table 2.--Soil moisture samplings, Denbigh, N. Dak. 1941 1/

Date	Depth in inches	Point A - Sod			Point H Hester furrow			Point S Cross-cultivated			Point I Scalps in dunes		
		Total moisture	Hygro. coeff.	Avail. moisture	Total moisture	Hygro. coeff.	Avail. moisture	Total moisture	Hygro. Coeff.	Avail. moisture	Total moisture	Hygro. coeff.	Avail. moisture
5/29/41	0-6	9.4	1.84	7.56	9.5	1.86	7.64	10.8	1.85	8.95	5.8	0.86	4.94
	6-12	7.9	1.38	6.52	8.0	1.28	6.72	8.0	1.50	6.50	6.7	0.72	5.98
	1-2	6.4	1.24	5.16	7.5	1.04	6.46	7.9	1.29	6.61	6.4	0.82	5.58
	2-3	5.0	1.07	3.93	6.8	1.01	5.79	5.5	0.96	4.54	5.2	0.92	4.28
	3-4	4.0	0.95	3.05	5.0	1.04	3.96	5.2	1.53	3.67	4.6	0.82	3.78
	4-5	4.9	1.08	3.82	7.0	2.14	4.86	5.1	1.87	3.23	4.4	0.76	3.64
	5-6	6.1	1.36	4.74	6.0	4.35	1.65	5.3	1.25	4.05	4.5	0.76	3.74
	Average	5.85	1.22	4.62	6.83	1.86	4.98	6.40	1.43	4.97	5.23	.81	4.41
6/19/41	0-6	7.2	1.84	5.36	7.3	1.86	5.44	9.4	1.85	7.55	3.1	.86	2.24
	6-12	5.5	1.38	4.12	5.2	1.28	3.92	7.8	1.50	6.30	2.7	.72	1.98
	1-2	5.1	1.24	3.86	4.7	1.04	3.66	6.2	1.29	4.91	3.6	.82	2.78
	2-3	4.9	1.07	3.83	4.7	1.01	3.69	4.8	.96	3.84	4.5	.92	3.58
	3-4	4.8	.95	3.85	10.2	1.04	9.16	5.2	1.53	3.67	4.8	.82	3.98
	4-5	5.5	1.08	4.42	6.8	2.14	4.66	8.7	1.87	6.83	5.1	.76	4.34
	5-6	6.4	1.36	5.04	8.7	4.35	4.35	10.4	1.25	9.15	5.2	.76	4.44
	Average	5.50	1.22	4.29	6.90	1.86	5.03	7.32	1.43	5.89	4.35	.81	3.54
7/14/41	0-6	6.2	1.84	4.36	7.9	1.86	6.04	8.0	1.85	6.15	3.7	.86	2.84
	6-12	5.9	1.38	4.52	5.9	1.28	4.62	6.4	1.50	4.90	4.1	.72	3.38
	1-2	3.9	1.24	2.66	2.5	1.04	1.46	6.4	1.29	5.11	4.1	.82	3.28
	2-3	3.7	1.07	2.63	3.4	1.01	2.39	5.3	.96	4.34	3.4	.92	2.48
	3-4	3.1	.95	2.15	3.6	1.04	2.56	4.8	1.53	3.27	3.6	.82	2.78
	4-5	4.1	1.08	3.02	4.5	2.14	2.36	6.3	1.87	4.43	3.6	.76	2.84
	5-6	5.8	1.36	4.44	5.2	4.35	.85	5.7	1.25	4.45	3.5	.76	2.74
	Average	4.45	1.22	3.22	4.35	1.86	2.49	5.95	1.43	4.52	3.68	.81	2.87
8/5/41	0-6	2.0	1.84	.16	4.5	1.86	2.64	3.9	1.85	2.05	2.1	.86	1.24
	6-12	1.4	1.38	.02	4.2	1.28	2.92	4.6	1.50	3.10	1.5	.72	.78
	1-2	1.9	1.24	.66	4.1	1.04	3.06	4.7	1.29	3.41	1.5	.82	.68
	2-3	2.9	1.07	1.83	4.0	1.01	2.99	3.4	.96	2.44	2.2	.92	1.28
	3-4	2.7	.95	1.75	4.9	1.04	3.86	4.0	1.53	2.47	3.0	.82	2.18
	4-5	3.2	1.08	2.12	6.2	2.14	4.06	4.9	1.87	3.03	2.9	.76	2.14
	5-6	4.1	1.36	2.74	8.0	4.35	3.65	3.5	1.25	2.25	3.0	.76	2.24
	Average	2.75	1.22	1.53	5.25	1.86	3.40	4.13	1.43	2.69	2.40	.81	1.59
9/22/41	0-6	10.7	1.84	8.86	10.6	1.86	8.74	11.7	1.85	9.85	5.8	.86	4.94
	6-12	7.3	1.38	5.92	8.3	1.28	7.02	8.3	1.50	6.80	6.1	.72	5.38
	1-2	6.8	1.24	5.56	3.9	1.04	2.86	7.6	1.29	6.31	6.1	.82	5.28
	2-3	5.0	1.07	3.93	6.0	1.01	4.99	4.7	.96	3.74	4.8	.92	3.88
	3-4	4.5	.95	3.55	3.7	1.04	2.66	5.2	1.53	3.67	4.8	.82	3.98
	4-5	5.2	1.08	4.12	6.9	2.14	4.76	6.0	1.87	4.13	5.2	.76	4.44
	5-6	5.6	1.36	4.24	8.2	4.35	3.85	6.1	1.25	4.85	5.6	.76	4.84
	Average	6.02	1.22	4.80	6.36	1.86	4.50	6.60	1.43	5.17	5.40	.81	4.60

1/ Hygroscopic coefficient = $\frac{\text{Moisture equivalent}}{2.71}$

Table 3.--Summary of available moisture in top 6 feet of soil in 4 different sites, Denbigh, N. Dak. 1941 1/

Date	Point A: Sod	Point H: Hester 4' furrow	Point S: Cross-cultivated	Point I: Scalps in dunes
5/29	4.62	4.98	4.97	4.41
6/19	4.29	5.03	5.89	3.54
7/14	3.22	2.49	4.52	2.87
8/5	1.53	3.40	2.69	1.59
9/22	4.80	4.50	5.17	4.60
Total	18.46	20.40	23.24	17.01
Average available moisture	3.69	4.08	4.65	3.40
Average hygro. coeff.	1.22	1.86	1.43	0.81
Net av. total moisture percent	4.91	5.94	6.08	4.21

1/ Available moisture is considered that in excess of hygroscopic coefficient. Point A is on Valentine fine sand a few feet from quadrat 8A in center of SE¼, Sec. 36. Point H is on Valentine fine sand in a Hester furrow 25 feet east of west end of the third tree row from the north end of Plantation 7A in northwest corner of SW of NW of Sec. 36. Point S is on Valentine fine sand and is 117 feet north of south end of Plantation 64, or is 120 feet northwest of quadrats 8A to 8F in center of SE¼ of Sec. 36. Point I is on top of a broad sand dune lying 25 feet above the level of the Valentine flats in Plantation 67, Black Hills spruce, and is located between rows 133 and 134 some 50 feet east of the west end of the plantation which is in W½, SW SW. Point is about 700 feet north of southwest corner of Sec. 36.

The lack of tree growth on the southwest slopes is probably attributable to intense solar radiation, high surface temperatures, lower soil moisture, higher wind velocities, and higher evaporation and transpiration rates.

To determine how much difference there is in soil surface temperatures on the two types of exposure, data was collected on July 22 and the information is plotted in figure 12. It is seen that on this day temperatures reached a maximum of 146 on the southwest slope and only 132 on the northeast slope with averages of 18 readings from 8:25 a.m. to 4:50 p.m. being 130° and 116° respectively for the two sites. Temperatures were 130° F. or over from 10:20 a.m. to 11:50 a.m. on the northeast slope, or for 1.5 hours. On the southwest slope they were above 130° F. continuously from 10:50 a.m. until 5:00 p.m. The ratio of soil surface to air temperature in the shade was 1.48:1 and 1.58:1 respectively for the peak soil temperature readings.

It seems certain that high temperatures on the southwest slopes are part of the reason for the lack of natural tree growth on the steeper southwest slopes of large dunes, and indicate one reason for difficulty of establishing plantations on the dune areas. These data were taken in two blowouts devoid of vegetation.

To get surface temperature relations on four classes of dune exposure with normal grass cover, data were collected on this July 22, 1941 on north, east, south, and west slopes

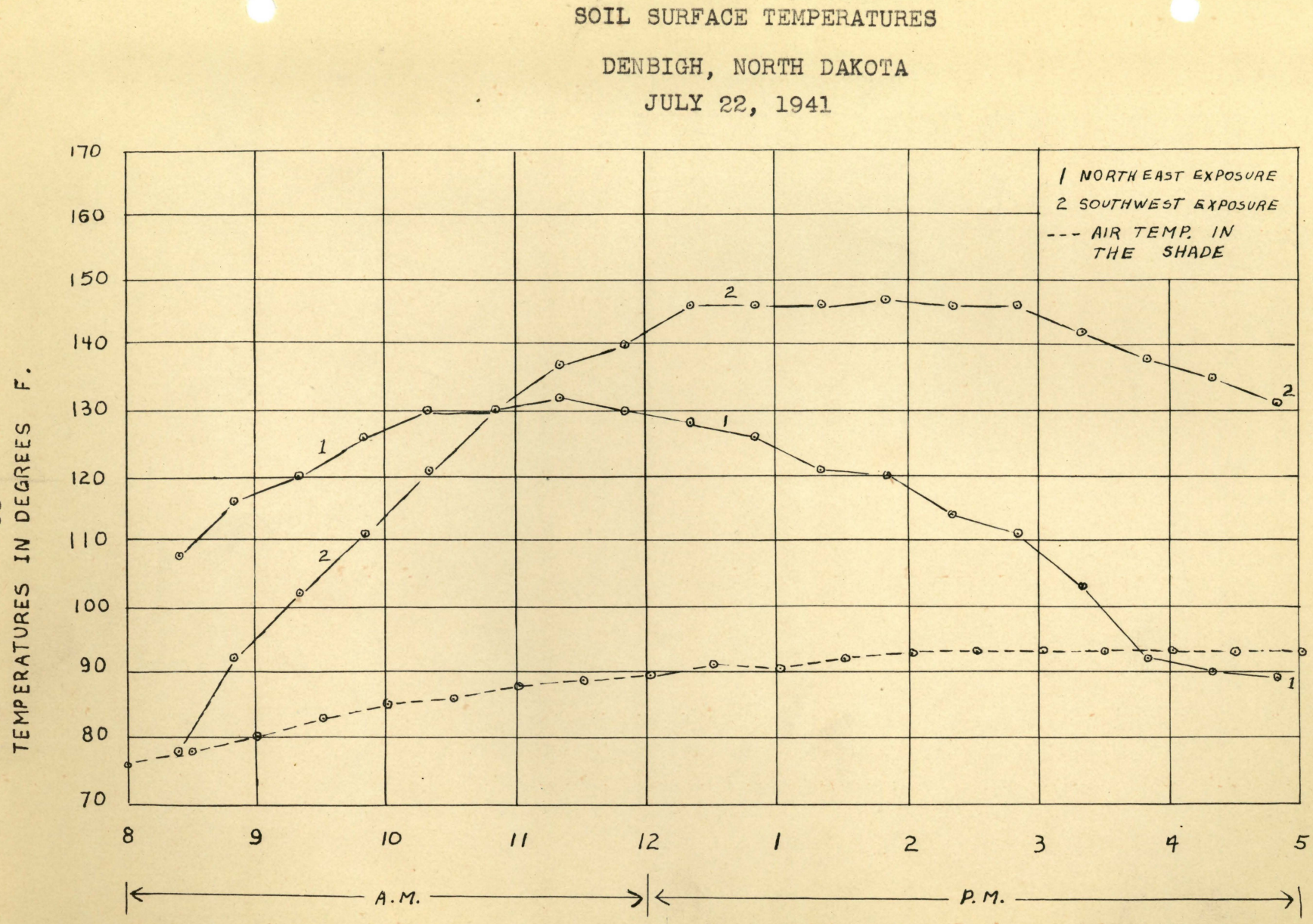


Figure 12.--Relation of air temperature in shade to soil surface temperatures on northeast and southwest slopes of sand dunes near Denbigh, N. Dak. July 22, 1941.

of a dune. The values are plotted in figure 13 and show clearly the temperature relations on the 4 exposures. As might be expected peak temperatures occurred in the following descending order of exposure: south, west, east, and north. Maximum value recorded was 152° F. on the south slope at a time when air temperature was 91.5. This ratio is 1.66:1.

Some additional data taken on effect of a light weed cover and of method of ground preparation are given in figure 14.

It is seen from comparison of the graphs that a light weed cover left in a Hester furrow caused a reduction of maximum temperature from 138° F. to 112° F. The light weed cover in this case consisted of a 6-inch wide strip of weeds left between the tree rows on a 4-foot-wide, frequently cultivated, Hester furrow. The vegetation density on the narrow strip was 0.5 and species were as follows:

Species	Height - Inches	Percent of basal area
Flea bane	18 - 36	92
Wild rose	14	2
Russian thistle	6	0.5
Chrysopsis villosa	8	2.0
Spartina pectinata	6 - 12	3.5

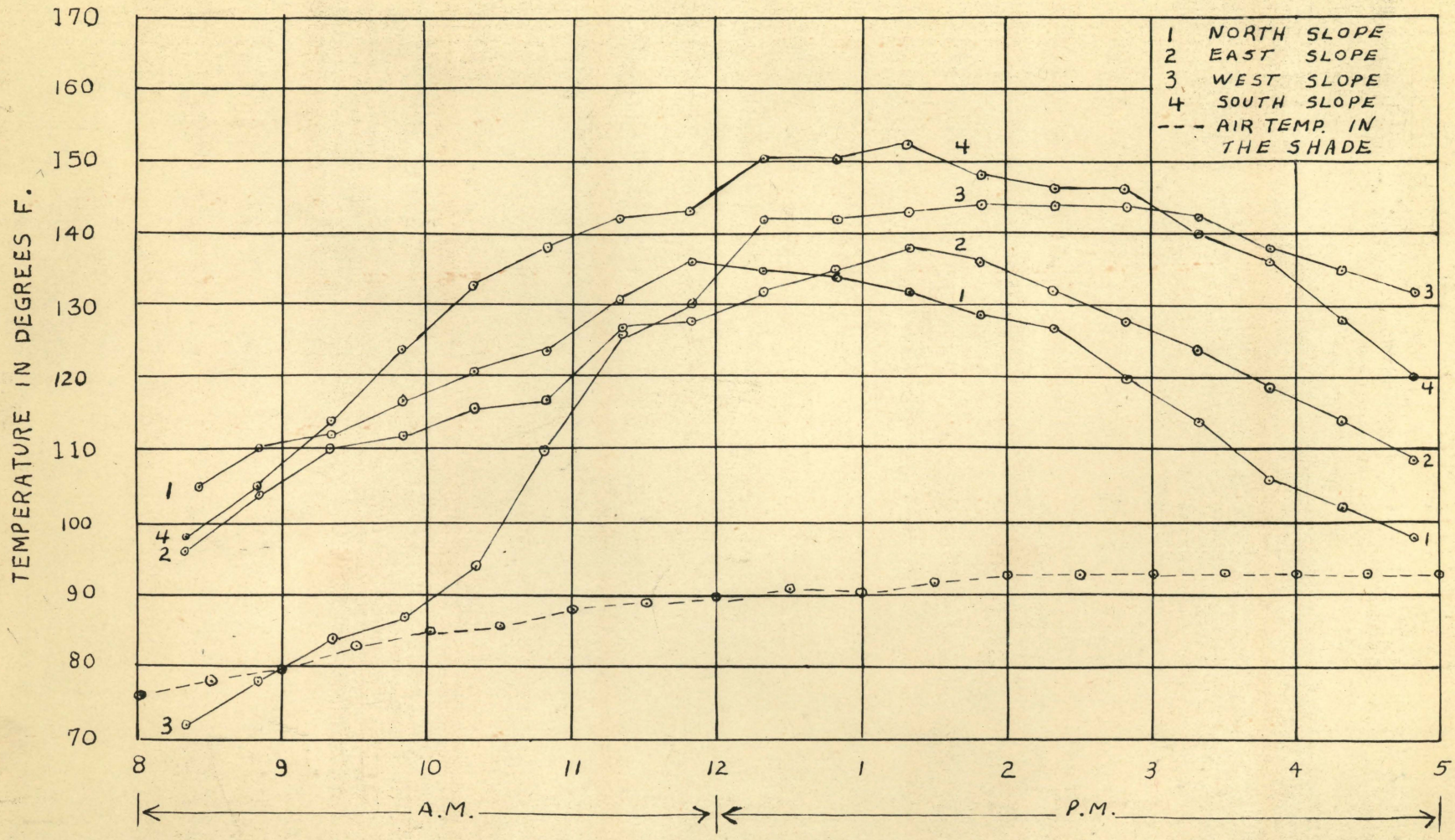


Figure 13.--Relation of air temperature in shade to soil surface temperatures on the north, east, south, and west side of sand dunes near Denbigh, N. Dak. July 22, 1941.

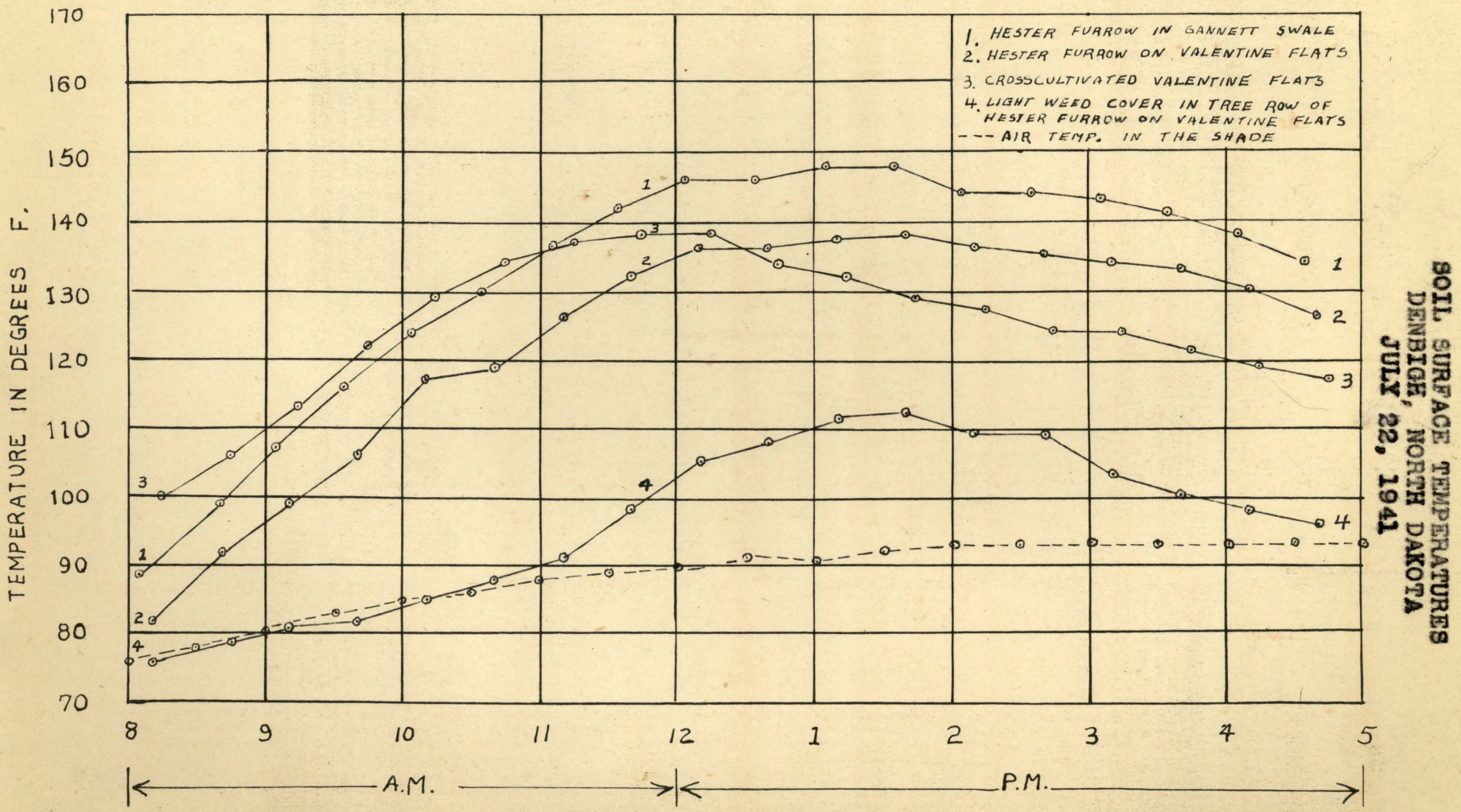


Figure 14.--Relation of air temperature in the shade to soil surface temperatures in sandy land near Denbigh, N. Dak. prepared for tree planting by different methods of ground preparation and with varying types of cultivation.

These temperature observations may have some bearing on the apparent lack of difference in survival on an experiment in Plantation 10B where rows 91 to 109, which were hand hoed, showed no difference in survival from rows 91 to 109, which were not hand hoed but given only the standard tractor cultivation.

The other graphs in figure 14 indicate that low spots in Hester furrow ground preparation tend to heat up more (due to lack of air movement) than the upland areas. Cross-cultivated upland areas, kept free of weeds, appear to warm up quicker in the morning than 4-foot Hester furrows but are cooler in the afternoon - a feature which could be considered desirable from a viewpoint of favorable growing conditions.

Data in figure 15 give a comparison of soil temperatures in a clean fire line, one area with top soil intact and the other with a foot of top soil blown away. Temperatures were usually higher where the top soil was intact (except in late afternoon) probably because of the almost black sod color there as compared with the light yellowish brown of the wind-eroded area. The differences are not, however, pronounced and represent nothing that would change our present concept of ground preparation or depth of plowing.

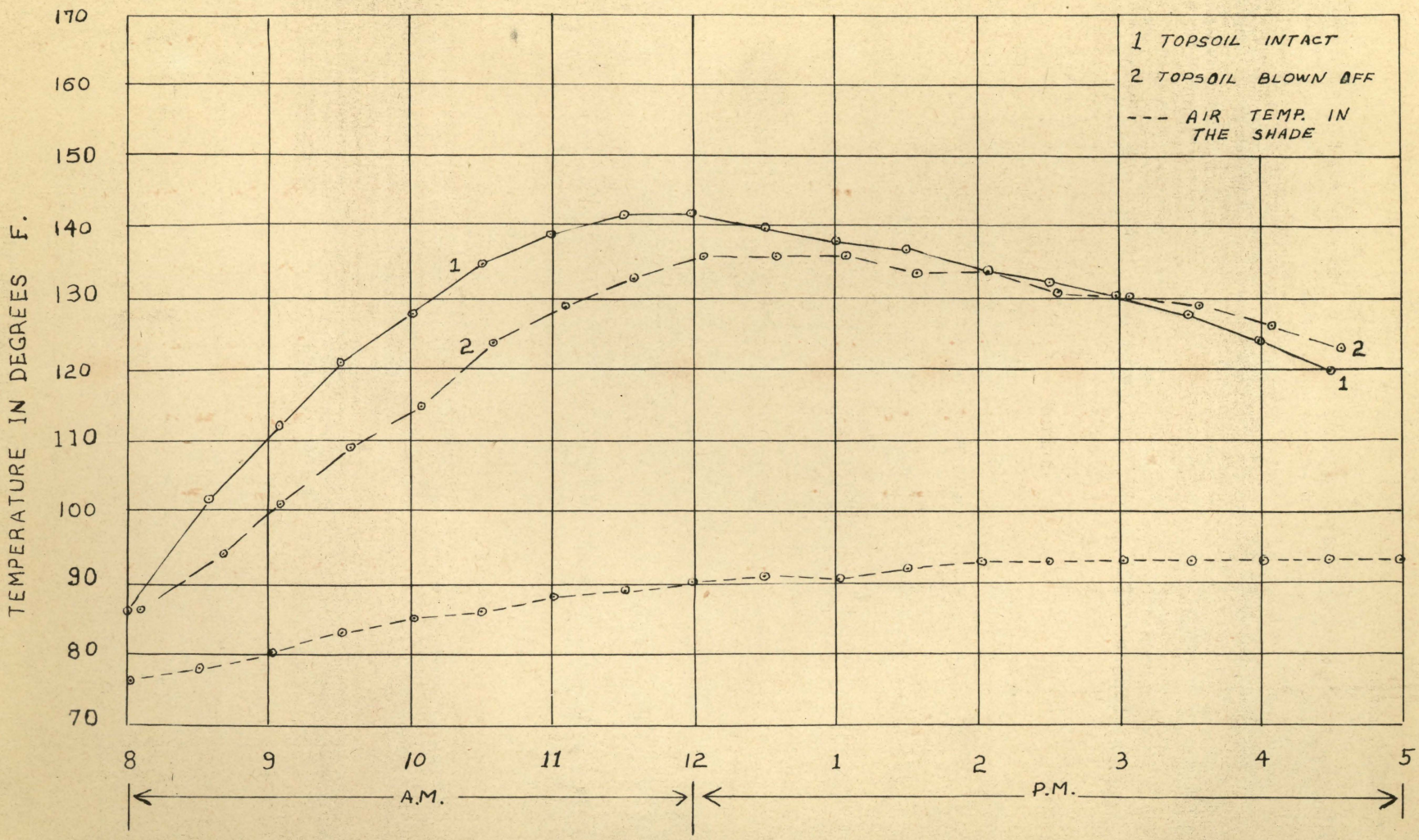


Figure 15.--Relation of air temperature in shade to several types of soil surface in sandy lands near Denbigh, N. Dak.

RESULTS OF 1941 GRASS SEEDINGS

In 1941 a few small plots were established to test 19 species of grasses to supplement data obtained from 1936 through 1940. Each plot consisted of 19 two-rod-long rows with an inter-row spacing of 2 or 3 feet. One plot was placed just to the west of the 1936 seedings on abandoned farm land north of Towner Nursery a few hundred yards. The other was placed in a wind-eroded field in East ½ of Sec. 19, T157N, R75W in the protection of a 6-year-old planting of cottonwood. The soil had been fairly well stabilized here and did not represent the wind erosion problem encountered in 1936 when wind erosion and sand blasting action were so severe that the only grass plots that succeeded were obtained by planting rhizones of Redfieldia flexuosa, a sand blow pioneer species.

The seeding was done on May 27 and exactly 5 grams of seed was used in each row of 2 rods. The data on stand and height are given in table 4.

It is seen from table 4 that only 8 to 10 out of 19 species produced any stand. Strangely, the wheat grasses which in past years have given fairly good results were very poor in this late spring seeding of 1941. This may be due to season of sowing because the wheat grasses are classified by the Soil Conservation Service as cool temperature species as is shown by the following table and are recommended for fall or early spring sowing.

Table 4.--Results of spring 1941 grass seeding, Towner, N. Dak. Seeded May 27, 1941.
Observations Sept. 29, 1941

Row no.	Species	Wind eroded fields 1/		Abandoned farm land		Remarks
		Plants per foot	Height in inches	Plants per foot	Height in inches	
1	Agropyron cristatum (Fairway)	0	-	0		
2	Agropyron cristatum (Standard)	0	-	0		
3	Agropyron inerme	0	-	0		
4	Agropyron pauciflorum (Austin)	0	-	0		
5	Agropyron smithii (Austin)	1/32	3	1/3	1	10 plants in 2 rods. Plants only a few weeks old.
6	Andropogon scoparius	Est.12	2	Est.25	1	Fair vigor.
7	Bouteloua curtipendula	Est.10	4	Est.20	1	Fair vigor.
8	Bouteloua gracilis	Est.12	2	Est.30	1	Fair vigor.
9	Bromus marginatus	0	-	0		
10	Buchloe dactyloides (Austin)	5/32	3	0		
11	Calamovilfa longifolia	4	6	Est. 8	3	Fair vigor.
12	Elymus canadensis (Austin)	0	-	0		
13	Elymus junceus	0	-	1/2	1	Poor vigor. Plants a few weeks old.
14	Oryzopsis hymenoides	0	-	0		
15	Phalaris arundinaceae (Austin)	0	-	0		
16	Poa secunda	0	-	Est. 4	1	Poor vigor. Plants 2-3 weeks old.
17	Sporobolus cryptandrus	0	-	1/4	1	Poor vigor. Plants 2-3 weeks old.
18	Stipa comata	19/32	3	[illegible]/2	2	Fair vigor. 68 plants.
19	Stipa viridula	1/32	3	1/3	2	Fair vigor. 10 plants.

1/ It was noted on the wind eroded field that there was a considerable invasion recently of bare areas by Calamovilfa longifolia. Much new Sporobolus cryptandrus is also appearing. The field in general is well stabilized.

Cool temperature grasses (Fall or early spring sowing recommended)	Warm temperature grasses (Late spring or early summer sowing recommended)
Stipa viridula	Bouteloua gracilis
Stipa comata	Panicum virgatum
Koeleria cristata	Andropogon scoparius
Oryzopsis hymenoides	Andropogon furcatus
Agropyron pauciflorum	Andropogon hallii
Agropyron smithii	Buchloe dactyloides
Agropyron cristatum (Standard and Fairway)	Bouteloua curtipendula
Sporobolus cryptandrus	
Agropyron inerme	
Poa secunda	
Calamovilfa longifolia	
Bromus marginatus	
Phalaris arundinaceae	
Elymus canadensis	
Elymus condensatus	
Elymus junceus	

RESULTS OF 1936, 1937 AND 1938 GRASS SEEDINGS

Grass seedings were made in the past as follows:

(1) May 9, 1936--38 species sown usually in 3-rod rows each.

(2) May 9, 1936--12 species sown in 1-rod square plots each.

(3) Oct. 13, 1936--24 species sown in 3-rod rows each.

(4) June 11, 1937--17 species sown in four 1-rod rows each.

(5) April 22, 1938--21 species sown in three 1-rod rows each.

In the May, 1936 seedings the outstanding species in the 3-rod rows, as of fall 1941, were: Stipa comata, stipa viridula, Buchloe dactyloides, Agropyron smithii, Koeleria cristata. Fair stands were obtained with Bouteloua gracilis, Agropyron cristatum, Panicum virgatum, and Poa nevadensis.

In the May 1936 seedings on sod square plots the outstanding plot in the fall of 1941 was Stipa comata; fair stands were obtained in Agropyron smithii, Koeleria cristata, Elymus canadensis, and Bouteloua gracilis.

In the October 1936 seedings excellent stands were present in the fall of 1941 in Oryzopsis hymenoides and Agropyron cristatum; fair stands in Agropyron smithii and Elymus canadensis.

In the June 11, 1937 seedings examined in the fall of 1941, fair stands were present in Oryzopsis hymenoides, Agropyron cristatum, and Sporobolus cryptandrus.

In the April 22, 1938 seedings examined in the fall of 1941, good stands were obtained with Agropyron smithii, Bouteloua gracilis, Oryzopsis hymenoides, and Stipa viridula; thin stands were obtained with Andropogon furcatus, Agropyron cristatum, Andropogon hallii, and Bouteloua gracilis.

Considering all results of older seedings to date and the ecological adaptability of the various species, it is seen that Stipa comata, Stipa viridula, Agropyron smithii, Agropyron cristatum, Oryzopsis hymenoides, Bouteloua gracilis and Koeleria cristata are the best species for abandoned farm land in McHenry County, and if the top soil is largely intact. The most feasible seeding practice would involve a mixture in which Stipa comata would constitute at least 50 percent of the mixture with some Bouteloua gracilis,

Agropyron cristatum and Agropyron smithii included in the mixture. Stipa viridula might be included but whether it will persist over a period of years is yet to be determined.

RABBIT DAMAGE TO PLANTATIONS

Because of lack of a caretaker in winter of 1939-1940, the most severe rabbit damage since 1937 was sustained by the plantations. When a caretaker is present on the area, continuous and systematic hunting keeps populations very low. The last rabbit drive at Denbigh was staged in December 1938 by E. J. Dortignac with a large crew of men. Hunting on 12 sections of land (640 acres per section), they got 15 rabbits per section on the first drive and 4 rabbits per section on a hunt of the same area made within a week of the first drive.

On November 28, 1941 under supervision of O. M. Patten an area of 3½ sections in and around the Denbigh plantations was hunted with 69 men and yielded 68 rabbits or 19.4 rabbits per section. The area hunted consisted of the Denbigh Station section, 1½ miles to east, 1 mile south, and ½ mile to north and west of the section fence. The yield of this hunt was almost identical to that of 1938.

The maximum number of rabbits found in 6 different 100 percent census periods between November 1936 and December 1938 was 73 on one full section and 78.4 per section on a

3-quarter section area. Census data taken on 6,000 acres in 1936 showed a population of 27 rabbits per section actually counted and because of the factor of "misses" in counts it is believed the normal at that time was about 30 rabbits. Therefore the drives appear to be taking out about two-thirds of the population.

Survival counts made in late summer of 1941 showed very heavy damage, especially to Chinese elm and cottonwood. Samples of damage percent are given below by species, some of which appeared in alternate rows in the same plantation.

P-12A	Chinese elm	97.8%
P-12A	Cottonwood	76.6%
P-6A	Rocky Mountain red cedar	22.6%
P-12E	Green ash	10.8%
P-34A	Ponderosa pine	7.3%
P-7A	Colorado blue spruce	4.4%

In the spring and early summer of 1941 jack rabbits killed on the station section of 640 acres were as follows:

8 shot in SE of SW April 20

2 shot in SE of SW April 21

2 shot in S½ of section May 5

1 shot near nursery May 5

1 shot in W½ SW SW May 9

1 poisoned in NW of NW May 12

2 shot in NW of NW June 11

1 shot in SE of SW June 18

3 shot in NW of SW July 2

4 poisoned on whole section July 2

1 shot on SE of SW July 8

3 shot NE of SW July 9

29 Total

This type of systematic hunting along with an occasional drive should do much to keep down population of rabbits so that damage will not be excessive.

WATER TABLE FLUCTUATIONS

This is the first year in the records of the Denbigh Station that a rise in water table level has occurred from spring to fall. Records taken since 1933 are compared in table 5. It is seen that in 8 of the years a lowering of water table has regularly occurred from spring to fall, ranging from 0.4 to 1.1 feet. Only in 1941 was this trend reversed when depth to water table decreased 1.1 feet from fall 1940 to spring 1941 and decreased an additional 1.3 feet during the summer of 1941, representing a raising of the water table by fully 2.4 feet compared with the previous fall, and thus regaining all of the loss which had accumulated during all the drought years since 1933.

Table 5.--Water table fluctuations in Well No. 5 in southeast corner of Sec. 36, T156N, R78W, McHenry County, N. Dak. 1/

Year	Depth to water in feet		Seasonal change in feet from June to Nov.	Cumulative lowering of water table in feet as of Nov. 1 compared with 1933
	June 15	Nov. 1		
1933	5.5	6.6	-1.1	--
1934	6.6	7.3	-0.7	-0.7
1935	6.9	7.3	-0.4	-0.7
1936	6.9	7.6	-0.7	-1.0
1937	7.1	7.8	-0.9	-1.2
1938	7.5	8.2	-0.7	-1.6
1939	7.7	8.4	-0.7	-1.8
1940	8.4	8.9	-0.5	-2.3
1941	7.8	6.5	+1.3	+0.1

1/ The fall 1941 reading was actually taken on Dec. 9.

The raising of water tables is attributed to the very heavy spring and fall rains of 1941, rains occurring at such a time when demands by plants and evaporation losses are very much less than in midsummer.

The rise in water tables--the first which has occurred in 8 years, is a hopeful sign and lends some credence to the apparent trend toward a "wet cycle" in the Great Plains.

The data for the whole season's records, taken twice a month, are given for 5 wells and 1 well point in the appendix of this report.

Besides the data obtained at Denbigh, we have observations made at Towner Nursery in 1934 and again in 1941 which indicate that water levels there are holding their own or even gaining a little.

The stations were labeled #1 to #4 respectively and their location is shown on the sketch below. Data is given in table 6.

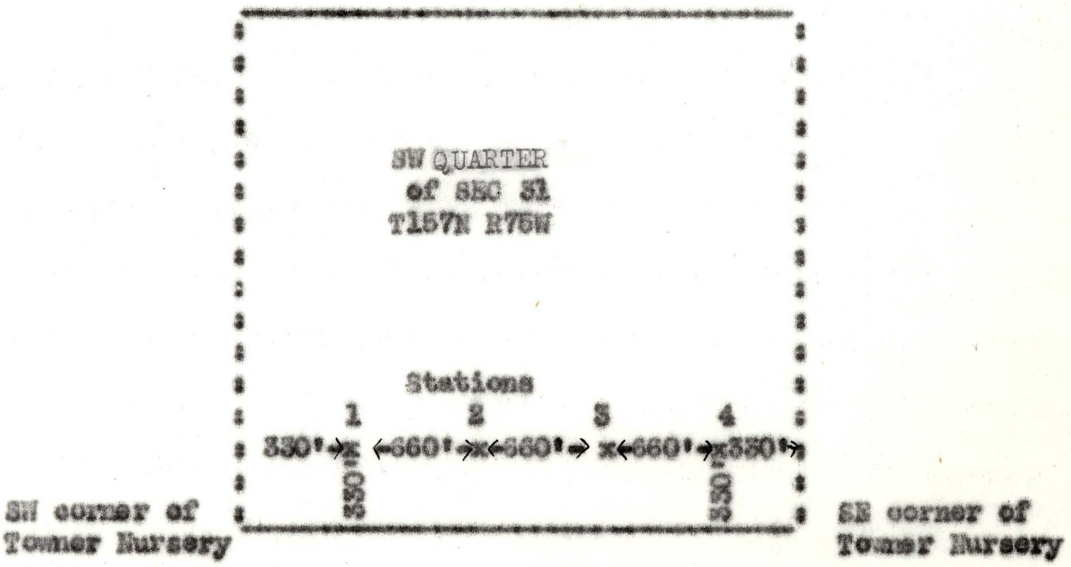


Table 6.--Water table levels at Towner Nursery in 1934 and 1941

Station No.	Depth in feet to water table		Rise in water level in feet
	Fall, 1934	Aug. 6, 1941	
1	16.6	15.4	+1.2
2	11.9	11.4	+0.5
3	10.5	9.7	+0.8
4	6.5	5.7	+0.8
	Average rise in feet - - - -		+0.8

It is seen that the average rise in water table is 0.8 feet and therefore there need be no alarm about water supply for irrigation in spite of the slight loss of water which occurs at the base of the slope west of the nursery 150 yards where peat is being excavated for use in building up the Towner Nursery soil.

STATUS OF DENBIGH ARBORETUM

In 1940 a start was made on converting the former Denbigh Nursery site to an arboretum of 40 small blocks each 35 feet square with a 3½ by 3½ foot spacing. Twenty-two of these blocks were planted in the spring of 1940 and eleven were planted in spring of 1941. Seven were unplanted as of spring 1941. See table 7.

The layout of the arboretum is shown below along with the permanent numbers of the blocks.

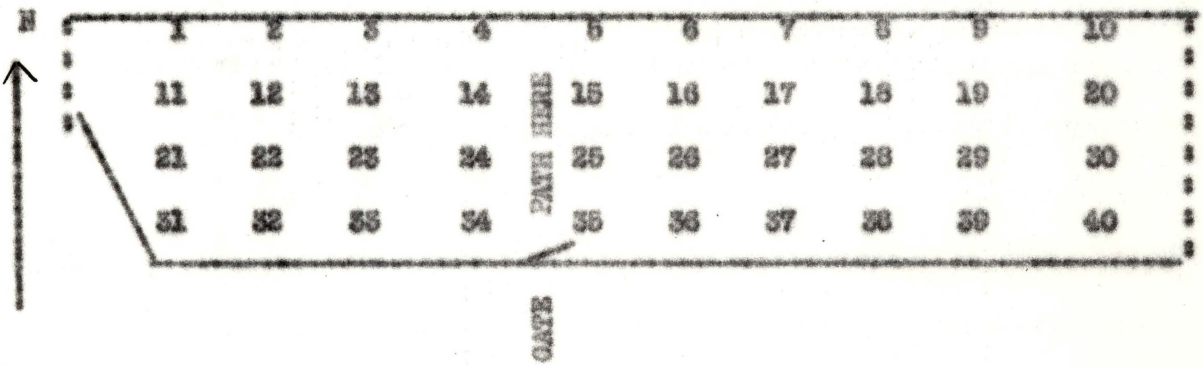


Table 7.--Status of Denbigh arboretum as of January 1, 1942

Plot No.	Species	Age class	Col. No.	Date planted	No. planted	Condition fall 1941	Recommended replants spring 1942 Species	Age class	Seed source
1	Poplar-hybrid	Cuttings	155-9	6-6-40	100	Poor	Black spruce	3-2	Chequamegon
2	Cottonwood	1-0	Mandan	6-6-40	100	O.K.			
3	American elm	2-1	N.Dak.	6-7-40	100	O.K.			
4	Ponderosa pine	2-2	380	6-7-40	100	Fair			
5	Jack pine	2-2-1	372	6-17-40	100	Poor	White cedar	3-2	Chequamegon
6	Douglas fir	4-2	377	5-20-41	100	Poor			
7	Not planted						Jack pine	2-0	Nicolet
8	Larix siberica	3-1	383	6-6-40	100	Fair			
9	Mixture of ponderosa, Scotch and Leucosperma pine	2-1	289	6-13-40	100	Fair			
10	Juniperus monosperma	3-2	338	5-24-41	100	Poor	Norway spruce	2-2	Hayward
11	Poplar-hybrid	Cuttings	53-9	6-6-40	100	Poor	Black locust	1-0	Idaho
12	Hackberry	1-3-1	321	6-6-40	100	O.K.			
13	Ponderosa pine	3-2	318	6-7-40	100	Fair			
14	Ponderosa pine	3-2	376	6-7-40	100	Fair			
15	Ponderosa pine	2-2-1	364	6-12-40	100	Fair			
16	Pinus resinosa	4-3	324	5-20-41	90	Poor	Red pine	2-2	Nicolet
17	Not planted						Rock elm	2½-0	Nicolet
18	Juniperus pyrmidalis	4-2	N.Dak.	6-10-40	25	Fair			
19	Juniperus scopulorum	2-2	361	6-17-40	100	Fair			
20	Picea excelsa	4-5	282	5-24-41	17	Poor	White ash	3-2	Chequamegon
21	Not planted						Hard maple	1-0	Nicolet
22	Picea pungens	3-2	405	5-21-41	100	O.K.			
23	Picea glauca albertiana	3-4	330	5-14-41	100	O.K.			
24	Golden willow	Cuttings	N.Dak.	6-10-40	100	Fair	Golden willow	Cuttings	
25	Russian mulberry	1-4		6-12-40	100	Fair			
26	Juniperus scopulorum	3-2	367	5-23-41	100	Fair			
27	Not planted						Mountain ash	3-0	Nicolet
28	Burr oak	7-0	320	5-24-41	100	Poor	Ginnala maple	2-0	Asia
29	Boxelder	2-0	A-38-39	6-18-40	100	O.K.			
30	Not planted						Manchurian ash	1-0	Manchuria
31	Pinus austriaca	2-1-5	Bot.	5-22-41	68	Fair	Austrian pine	2-3	
32	Picea glauca	4-4	335	5-21-41	70	Poor	White spruce	2-2	Nicolet
33	Juniperus communis	5-0	342	6-10-40	80	Fair	J. communis	2-0	
34	Russian olive	5-0	326	6-10-40	100	Good			
35	Tamarix pentandra amurensis	Cuttings		6-11-40	100	Fair	Tamarix	Cuttings	Amur River
36	Pinus flexilis	4-2	371	5-23-41	100	Poor			
37	Not planted								Lake States
38	Black haw	3-0	391	6-17-40	22	Poor	Black locust	1-0	East Tawas, Mich.
39	Crataegus	3-0	358	6-17-40	100	Poor	Honeysuckle	2-0	North Dakota
40	Not planted						Green ash	2-0	North Dakota

The species planted in each block, usually of 100 trees, are given in table 7. Also included are recommendations for spring 1942 replants to fill in unplanted blocks, failed blocks, or failed spots within blocks.

It is possible to add a few more blocks at the east end of the arboretum, labeled perhaps as 10A, 20A, 30A, and 40A, in which a few other species could be added, notably 2 lots of 1-0 black locust now at Towner Nursery, one from Idaho seed and the other from East Tawas, Mich.

This arboretum is so arranged by cross-checked rows that cultivation can be done with the Allis Chalmers tractor which reduces hand work to an absolute minimum. It should prove a valuable addition to the station from a demonstration viewpoint once the trees are 3 to 4 years old.

It is possible that only that planting can be done in the arboretum for those blocks which have the designated species available at Towner or Denbigh Nursery. This may leave some blocks still unplanted after the spring 1942 replanting. Stock for planting plots 11, 28, 30, 38, 39, and 40 is available at Towner Nursery. Cuttings for plots 24 and 35 can be obtained from these same plots in the arboretum. These plots do not have a fully stocked stand. The tamarack for plot 37 could be taken from some large trees at the west end of Denbigh Nursery which are in a transplant bed.

If no Lake States species can be obtained this spring plots 7, 17, 21, 27, and 37, and perhaps one or two others will have to be left unplanted or filled in at some later date. If planted this spring with any species desired to use as a fill in, it is suggested that boxelder or green ash be used.

STATUS OF DENBIGH PLANTATIONS

In the fall of 1941 all plantations at Denbigh except those planted in 1931 were counted for survival data and measured for height.

These are given in detail in the tables in the appendix of this report and the maps show location of the plantations. One map showing the plantations in the west half of Sec. 36 and in the NW of SE quarter is on the scale of 1 inch = 660 feet. It will be useful in connection with the map showing ground preparation and cultivation for anyone who looks over the plantations or for future cultivation. It does not include all details of planting or age of species or dates of planting.

The 8 maps on a scale of 1 inch = 220 feet will be useful in any future survival counts, especially if used in connection with the tables of plantation status in the appendix of this report.

The larger scale maps generally have all details shown except for the W½ of SW of SW of Sec. 36, where there was not adequate space to put in all details of the plantation. They are drawn as close as was possible to scale.

The important things to be learned from the planting experiments to date are (1) that intensive cultivation is necessary for good survival and growth of cottonwood, which is the most moisture demanding species used in our planting work. (2) Hand hoeing of weeds in the 8-inch wide tree rows of juniper planted on 5-foot cultivated strips did not seem to justify itself in 1940 and 1941. This is indicated in table 3 but it must be remembered that these were two wet years and that juniper is more drought hardy than most of the other species so the test may not be conclusive. (3) Grading of seedling ponderosa pine stock planted in 1935 gave survivals of 22.1 and 1.4 percent respectively (table 8) and indicates that seedling stock should be culled and the culls discarded. (4) Shading of conifers planted on the droughty dune areas is worth while for some age classes. In 1935 an initial test was made of this and the seventh year survival of shaded and unshaded ponderosa pine was 29.0 and 8.8 percent respectively in fall, 1941. Shade consisted of recently cut brush of chokecherry of ½ to 2 inches in diameter which was placed over the tree immediately after planting. The amount of brush used was not large and usually consisted of 3 to 5 pieces.

Table 8.--Results of stock grading, plantation shading, and hand hoeing of tree rows in plantations

Plantation No.	Date planted	Age class	Species	Rows in plantation	Ground preparation	After care	Survival fall '41	Average height of trees in inches	Remarks on stock
26A	1935	2-0	Ponderosa pine	1 to 23	12" furrows	None	22.1	14	Large seedlings
26A	1935	2-0	Ponderosa pine	24 to 27	12" furrows	None	1.4	12	Small seedlings
35	1934	1-1-1	Ponderosa pine	21 to 25	Scalps	Brush shade	29.0	15	Dead brush put over scalps
35	1934	1-1-1	Ponderosa pine	26 to 28	Scalps	No shade	8.8	10	No brush
35	1934	1-1-1	Ponderosa pine	29 and 30	Scalps	None	0.9	13	40% needles cut off before planting
10B	1940		J. scopulorum	80 to 90	5' plowed strip	Cultiv.	93.5	13	Hand hoed between tree rows in 1940 and 1941
10B	1940		J. scopulorum	91 to 102	5' plowed strip	Cultiv.	90.6	15	No hand hoeing

Costs of shading in a subsequent 1941 test were not unduly high, since the original field records show this was done on May 6, 8, 9, 12, 13, 14, and 15, or a total of 7 working days of 8 hours each or 56 hours[1/] to shade 40 rows of 600 feet length containing 6,996 trees or at the rate of 125 per hour once the brush had been spread along the tree rows. Brush cutting and dragging into place is estimated to have cost at least as much as putting it into place over trees. This would then amount to about 60 trees per hour or about 6.66 per thousand trees.

It is believed that for dune planting over a period of years that shading could perhaps be justified with some species where intermediate or small sized stock is used.

In table 9 are given survival figures for 8 plantations of 10 rows each, 4 of ponderosa pine, 3 of juniperus scopulorum, and 1 of Scotch pine planted in spring of 1941. Half of each plantation was brush shaded. Some very definite trends are evident. It is obvious that the red cedar is eager to establish than ponderosa pine or Scotch pine. Also the smaller the stock within a given species the greater the benefit from brush shading with maximum value to 2-0 stock. Pine benefited more than juniper. It is also seen

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1/ It is assumed that full 8-hour days were expended on this work. The time sheets at Denbigh give the exact number of hours expended in the various operations and a copy of a letter in the files there, written in midsummer of 1941 gives this in detail.

Table 9.--First year results of brush shading and age class test of spring 1941 planting on dune sand. All planting done in scalps. All counts 100 percent.

Plantation No.	Age class	Species	Rows in plantation	Survival fall '41	Average height in inches	Remarks on stock
70	2-0	Ponderosa pine	151-155	64.9	4	Brush shade
70	2-0	Ponderosa pine	156-160	42.4	4	No brush shade
69	2-1	Ponderosa pine	141-145	92.1	4	Brush shade
69	2-1	Ponderosa pine	146-150	87.0	5	No brush shade
71	2-2	Ponderosa pine	161-165	67.8	8	Brush shade
71	2-2	Ponderosa pine	166-170	53.8	8	No brush shade
72	3-2	Ponderosa pine	171-175	83.2	8	Brush shade
72	3-2	Ponderosa pine	176-180	84.2	8	No brush shade
74	2-0	J. scopulorum	191-195	95.9	5	Brush shade
74	2-0	J. scopulorum	196-200	78.7	3	No brush shade
73	2-1	J. scopulorum	181-185	99.2	7	Brush shade
73	2-1	J. scopulorum	186-190	94.7	7	No brush shade
75	2-2	J. scopulorum	201-205	97.6	13	Brush shade
75	2-2	J. scopulorum	206-210	97.1	13	No brush shade
76	2-2	Scotch pine	211-215	53.1	7	Brush shade
76	2-2	Scotch pine	216-220	39.3	8	No brush shade

that 2-1 ponderosa gave better survival than 2-2 stock, indicating that on the dry dune sand planting, ponderosa pine must have better balance than when planted on cultivated land where ordinary 2-2 stock generally gives better survival at Denbigh than 2-1.

It is expected that in the next few years even greater contrast will occur in survival of the brushed and ordinary type of planting in these 8 plantations. A similar test ought to be conducted with 1-1 and 2-0 jack pine some time in the future.

Observations on Plantations and Need of Future Replants

In the fall 1941 count, each plantation was sized up and notes made to supplement the survival and height data on the vigor and need of replanting, if any. This is listed separately by individual plantations in table 10.

The table indicates which plantations need replanting and the relative priority of replanting. It is worth while to record here that all survival counts made in fall 1941 are based on record of total trees planted as compiled by Manning and Dortignac for past reports. For any spring 1941 replants the basis of computation was considered as the total number of trees originally planted, plus new replants. In judging need of replanting, vigor of plants and stocking per acre were used rather than actual survival

Table 10.--Observations on Denbigh plantations and need for future replants. Fall, 1941.

Plantation No.	Vigor	Replant	Remarks
			E½ of NW of NW
12	Fair	No	Slow growth rate; survival and vigor best on upland well-drained knolls of Valentine sand; here trees are 12 to 24 inches high. In the alkaline Gannett loamy sand swales the trees planted in 1932 are only 4 to 6 inches high, chlorotic in color, and of poor vigor and growth, sometimes affecting terminal bud development so seriously that no terminal buds were able to form and live.
12A	Fair	No	Very heavy rabbit damage. May need pruning to form single stem.
12B	Fair	No	Very heavy rabbit damage. May need pruning to form single stem.
12C	Fair	No	
12D	Fair	No	
12E	Fair	No	
12F	Fair	No	
12F	Fair	No	
12G	Fair	No	
			W½ of NE of NW
16A	Fair	No	
17	Very poor	Yes	Could plow up entire plantation. From rows 1 to 85 there are numerous patches of aspen from 20 to 100 feet in diameter and 10 to 20 feet high. From row 85 south to row 211 the area is quite free of aspen and is an easier planting chance.
			E½ of NE of NW
18	Very poor	Yes	Could plow up entire plantation.
19A	Poor	Yes	
20	Very poor	Yes	Plow up and replant
21	Poor	No	Save this plantation as an example of growth and survival in 12-inch furrows.

Table 10.--Observations on Denbigh plantations and need for future replants. Fall, 1941 (Continued)

Plantation No.	Vigor	Replant	Remarks
			E½ NE NW (Continued)
22	Fair	No	Save this plantation as an example of growth and survival in 12-inch furrows.
23	Fair	No	Growth is best on Valentine sand knolls; poorest in the alkaline Gannett swales. Save as example of results in 12-inch furrows.
24	Very poor	Yes	Could plow up entire plantation.
			E½ SW NW
1	Very poor	No	Leave as example of growth in 12-inch furrows. It would be an interesting experiment to take the south half of the plantation, i.e. 10 rows and rip up sod between them and disk for 3 to 5 years to observe ability of a long-stagnated and sod-bound plantation to recover.
1AR	Poor	Yes	Replant with cottonwood.
1BR	Poor	Yes	There are a few burr oak present from previous plantation; could replant to cottonwood.
1C	Fair	No	
1D	Fair	No	Ponderosa pine in fair vigor; burr oak poor.
1E	Fair to poor	Yes	Ponderosa pine is OK, don't replant; cottonwood is poor and needs replanting.
1F	Fair	No	Ponderosa pine is good; g. ash is fair.
1G	Good	No	
5	Very poor	Yes	Plow up entire plantation and replant with pine or juniper.
5A	Poor	Yes	Could improve by replanting with 1-1 jack pine.
5B	Poor	Yes	Could improve by replanting with 1-1 jack pine.
			W½ SW NW
6A	Good	No	
6B	Good	No	Trees appear to have been slightly winter injured.
7A	Fair	No	Soil probably not fertile enough for good growth of spruce.
7B	Fair	No	Soil probably not fertile enough for good growth of spruce.
9	Fair to poor	No	This 1932 plantation has the best and most vigorous trees in a clump of aspen about 8 feet high and having about 50 percent of full sunlight. Perhaps juniper should be grown in alternate rows with green ash, or even cottonwood for best results.

Table 10.--Observations on Denbigh plantations and need for future replants. Fall, 1941. (Continued)

Plantation No.	Vigor	Replant	Remarks
			W½ SW NW (Continued)
6BB	Good	No	The 4 rows of this plantation are just south of P-9.
10A	Good	No	Rows 80 to 90 were cultivated and hand hoed in 1940 and 1941; rows 91 to 109 were cultivated but not hand hoed in 1940 and 1941. There is no apparent benefit from hand hoeing of juniper. Row 109 is not a full row; it is only about 80 percent full length.
			E½ NW SW
24B	Good	No	This is a fairly good plantation as far as growth is concerned.
24C	Poor	?	Area has choppy topography and quite a few aspen clumps up to 20 feet high. Don't cultivate in future because of danger of tractor tipping over. Could be replanted with pine or juniper and brush shaded.
24D	Poor	?	Same remarks as for P-24C.
24E	Poor	?	Same remarks as for P-24C. From row 36 south topography is somewhat smoother.
24F	Poor	Yes	Replant with cottonwood. Soil is Valentine and is smooth.
24G	Poor	Yes	Very heavy rabbit damage in both Chinese elm and Scotch pine. Damage in pine is heaviest seen on any Denbigh plantations. Replant the pine with ponderosa pine or juniper.
24HR	Poor	Yes	Soil is Valentine; replant with cottonwood.
24IR	Poor	Yes	Replant with cottonwood; there are a few burr oak from former plantation.
24J	Good	Yes	Could replant failed spots with juniper or with ponderosa of same seed source.
24K	Good	No	
24L	Good	Yes	Could replant failed spots with juniper or with ponderosa of same seed source.

Table 10.--Observations on Denbigh plantations and need for future replants. Fall, 1941. (Continued)

Plantation No.	Vigor	Replant	Remarks
			W½ NW SW
26A	Fair	No	Save as example of results in 12-inch furrows.
26E	Poor	Yes	Fill in failed spots with green ash or juniper.
26F	Poor	No	Trees in poor vigor because of soil alkalinity. Soil is almost all Gannett.
26G	Fair	No	
27B	Very poor	Yes	Replant with cottonwood or juniper.
27C	Fair	No	Soil is all Gannett series.
27D	Very poor	Yes	Soil is over 90 percent Gannett; too alkaline for jack pine; replant with cottonwood.
27E	Fair	No	There are 4 rows of empty scalps between row 27 and row 28.
28A	Fair	Yes	Soil is Gannett; replant with cottonwood. Row 7E has 4 juniper in it.
28B	Fair	No	
31B	Poor	Yes	Replant with cottonwood or green ash.
31C	Poor	Yes	Replant with cottonwood or green ash.
31D	Poor	Yes	Replant with cottonwood or green ash.
31E	Very poor	?	Juniper is unthrifty and some of it may die in winter of '41-'42. Some burr oak is present in plantation. If replanted use green ash or cottonwood.
31F	Fair	No	This will be an interesting plantation of alternate row ponderosa pine and Chinese elm.
			NE of SW
49	Fair	No	Should be an interesting mixture of species.
50	Fair	No	Good stocking.
51A	Fair	?	Replanting not of high priority; if done use cottonwood.
51	Poor	Yes	Scheduled for replanting in spring 1942. Rows 86-87 for 1-0 black locust of Idaho source; rows 88-89 for 1-0 black locust of East Tawas, Mich. source; rows 90-91 for 1-0 Manchurian ash from U.S.S.R.
52	Fair	No	Well stocked.
53A	Fair	Yes	Could improve by filling in failed spots with juniper or pine of same seed source.
54A	Poor to fair	No	Well stocked. Spruce in poor vigor; ash is fair but rabbit damage has resulted in formation of 2 to 5 stems in ash. In the future a pruning experiment might be installed where in the north 3 rows all except 1 stem is cut out and leaving the south 2 rows as checks.

Table 10.--Observations on Denbigh plantations and need for future replants. Fall, 1941. (Continued)

Plantation No.	Vigor	Replant	Remarks
			W½ SE SW
55A	Fair	?	Could improve by replanting with juniper, ash, or pine of same seed source.
55B	Fair	?	Could improve by replanting with juniper, ash, or pine of same seed source.
55C	Fair	?	Could improve by replanting with juniper, ash, or pine of same seed source.
55D	Poor	Yes	Survival low. Replant with juniper or pine of same seed source.
55E	Fair	?	Could improve by replanting with juniper, ash, or pine of same seed source.
55F	Fair	?	Could improve by replanting with juniper, ash, or pine of same seed source.
56	Good	No	These 4 rows of cottonwood on 30' wide plowed strip are next best in vigor to cross cultivated.
57	Very poor	Yes	Plantation a failure. Replant this 30' strip with cottonwood, pine, or juniper. There is a 40 foot wide unplanted space between P-56 and P-57 which has three 5-foot-wide plowed strips on it now grown up to weeds.
57A	Very poor	Yes	Plantation a failure; replant with cottonwood, ash, pine, or juniper.
57B	Fair	?	Could be improved by replanting failed spots with juniper of same seed source, or pine, ash, or cottonwood. There is a 30 foot wide unplanted strip between P-57A and P-57B. Weedy, hard to count accurately.
			E½ SE SW
58	Fair	No	Trees are on 15 foot wide strips with 2 tree rows per strip. Weedy. Hard to count.
58A	Fair	No	Trees are on 15 foot wide strips with 2 tree rows per strip. Weedy. Hard to count.
59	Fair	No	Trees are on four 30-foot-wide plowed strips with 4 rows per strip. Weedy. Hard to count.
59A	Fair	No	Trees are on two 30-foot-wide plowed strips with 4 rows per strip. Weedy. Hard to count.

Table 10.--Observations on Denbigh plantations and need for future replants. Fall, 1941. (Continued)

Plantation No.	Vigor	Replant	Remarks
			W½ SW SW
34A	Poor	No	Survival fair. Soil is semi-dune. Trees are of poor vigor under heavy shade of aspen or willow. Needs release of overstory on 10 to 15 percent of area.
35	Fair	No	Serious rabbit injury over a period of years. Trees would be 24" to 30" high if not cut back repeatedly by rabbits. Poor form on some trees due to several stems. Best survival in center of area in an old blowout where competition was less severe than on rest of plantation.
36	Poor	Yes	Could replant with brush shaded juniper.
37A	Fair	Yes	Could replant with brush shaded juniper; there is one white spruce in shade of aspen in rows 41 and 42.
37B	Poor	Yes	Could replant with juniper. About 40 percent of area has brush or aspen cover.
38AR	Poor	No	Survival fairly good. Needs release from brush and aspen on 30 percent of area.
38BR	Poor	No	There are 5 hackberry in row 54 and 2 in row 55 from previous planting.
38CR	Poor	Yes	Could replant with brush shaded juniper; there is brush cover on 10-15 percent of area; a few white elm remain from previous planting.
39	Poor	Yes	Could replant with juniper; 40 percent of area is brushy.
40A	Poor	Yes	Could replant with juniper; 40 to 50 percent of area is brushy.
40BR	Poor	Yes	Could replant with juniper; 70 percent is brushy.
41A	Fair	No	50 percent of area is brushy. Platte River juniper doing O.K. in shade.
42AR	Fair	Yes	20 percent brushy; rest easy planting chance. Replant with juniper or ponderosa.
43ARA	Fair	?	Could fill in gaps with juniper.
43ARB	Fair	?	Could replant with ponderosa pine or jack pine.
43ARC	Poor	Yes	Easy planting chance. Replant with juniper, ponderosa, or jack pine.
43BR	Very poor	Yes	Only 2 rows in this plantation. Replant with same species as P-43ARC.
67	Poor	No	Vigor poor partly because of late planting; soil may be too poor for spruce.
68	Poor	No	Vigor poor partly because of late planting; soil may be too poor for Douglas fir.

Table 10.--Observations on Denbigh plantations and need for future replants. Fall, 1941. (Continued)

Plantation No.	Vigor	Replant	Remarks
			W½ SW SW (Continued)
69	Fair	No	Slight advantage for brush shading.
70	Fair	No	Good advantage for brush shading.
71	Poor	No	Fair advantage for brush shading; many unthrifty trees.
72	Poor	No	No advantage for brush shading; many unthrifty trees.
73	Fair	No	Slight advantage for brush shading.
74	Fair	No	Good advantage for brush shading.
75	Very poor	No	No advantage for brush shading; many unthrifty trees because of poor balance.
76	Poor	No	Fair advantage for brush shading; many unthrifty trees; there is an unplanted space of 110 foot width between row 220 and the south boundary fence.
			E½ SW SW[1/]
45	Poor	No	Save as demonstration of results in scalps.
46	Poor	?	Plantation a failure. Low priority for replant. If done, plow area first.
47A	Very poor	?	Plantation a failure. Low priority for replant. If done, plow area first.
47B	Very poor	?	Plantation a failure. Low priority for replant. If done, plow area first.
47BR	Fair	?	Soil is semi dune; could fill in failed spots with juniper.
47CR	Fair	No	
47DR	Poor	?	Low priority for replanting of scalps; if done use juniper.
47ER	Fair	No	
47FR	Poor	No	
47F	Very poor	?	Soil is semi dune; of low priority for replanting.
47GR	Poor	?	Very heavy cherry cover; of low priority for replanting.
47HR	Poor	?	Very heavy cherry cover; of low priority for replanting.
47iR	Poor	?	Very heavy cherry cover; of low priority for replanting.

1/ The north half of E½ SW SW, area about 8 to 10 acres, has deep scalps and would be very hard on equipment if it were to be plowed.

Table 10.--Observations on Denbigh plantations and need for future replants. Fall, 1941. (Continued)

Plantation No.	Vigor	Replant	Remarks
			NW of SE
60	Good	No	Trees dropping leaves prematurely in late August on plantations 60 to 66 because of a yellowish leaf rust which had caused about 30 percent defoliation as of August 22, 1941 with heaviest defoliation at base of tree. The willow leaf beetle has done a little defoliation and was present on date of making counts.
61	Good	No	Ditto
62	Very good	No	Ditto
63	Very good	No	Ditto
64	Very good	No	Ditto
65	Very good	No	Ditto
66	Very good	No	Suggest that in 1943 P-66 be given only one good cultivation both lengthwise, and crosswise, if necessary about in June to determine if cultivation can be tapered off in third year after field planting of cottonwood.

percent. In some cases seed source was given considerable weight because it is felt that plantations of such species as ponderosa pine and *J. scopulorum*, where we have a good range of valuable seed sources, should not be replanted except to fill in the gaps with a different species which would never be confused in field counts with the original planting. The other alternative was to replant with species of the very same seed source, but this will be very hard to do after 1944 because of lack of the proper planting stock.

Among important observations which were apparent from examination of the different plantations in spring and in fall, 1941 were the following:

(1) Juniper seemed to tolerate 50 percent shade of brush or aspen and in fact was better under shade than in the open. Perhaps this species may fare best when planted in alternate row mixtures with green ash, cottonwood, or Chinese elm, especially the first two because they would have more value for fence posts, lumber, and other timber products than Chinese elm. More tests of this ought to be installed in the future.

(2) Ponderosa pine does poorly in shade and competition of dense cherry or willow brush or of aspen and either must be released or should not be planted on such sites.

(3) Ponderosa and jack pine become very chlorotic and have very poor vigor in alkaline Gannett swales. Juniper

seems better adapted but whether it would come through in the long run remains to be seen. Green ash does fairly well in Gannett swales and cottonwood does best.

(4) Ponderosa, Scotch, and jack pine do best on well-leached dune sand or on Valentine sand.

(5) Douglas fir does poorly on the alkaline Gannett swales.

(6) Rabbit damage is very severe near and in dune areas where there is brush cover nearby. It is most serious on jack and Scotch pine and rather serious on ponderosa. Juniper is hit some but not as badly as pine. On the flat areas clean cross-cultivation will tend to give maximum growth and creates a less favorable rabbit habitat.

(7) Rabbit damage to some plantations has formed 2 or 3 stemmed trees in some cases and it is suggested that in the future some experiments in pruning and thinning be considered.

(8) Cottonwood in years of above normal rainfall, like 1941, is affected by a yellow leaf rust which sets the plants back a little but at present does not seem to warrant doing any spraying with Bordeaux mixture.

(9) In 1941 for the first time the willow leaf beetle was observed on cottonwood but caused only slight defoliation.

(10) On the night of May 22, 1941 temperatures dropped to 28° F. Leaves of green ash and burr oak turned black and most damage was done in low spots and in Hester furrows.

(11) Observations made by Manning on April 24, 1941 indicated that all species of trees had some rabbit damage. He indicated Chinese elm, cottonwood, and green ash were especially hard hit while ponderosa pine was not chewed up so badly. He indicated that as long as plants were below snow line in winter they were fairly safe, but had heavy damage above snow line. It appeared that some of the clipping of branches was done without the material being eaten by the rabbits. Old plantings of juniper do not have very serious damage but one-year-old plantings had considerable damage especially where they had made good growth and were succulent. Damage on juniper was negligible in places where a moderately heavy weed cover was left on a strip 6 inches wide in the tree rows or in swales where Russian thistle covered the juniper. Damage was worst on knolls or where the cedar had been hand hoed completely clean. It is believed that in conifer plantations no weeds should be hand hoed from around the trees or in the tree rows after about July 15 to August 1, so that a moderate weed growth can aid in protecting the tree and making it less easy for rabbits to find. This protective effect of thistle was especially noticeable during the winter of 1940-41 in the cross-cultivated cottonwood plantations in P-60 to P-66 in the NW of SE where the 1-year-old plants of cottonwood often had a single Russian thistle plant growing at the base of the tree. This slight amount of competition

did not harm the trees, as evidenced by excellent survival and growth, but still the dry spiny structure of the 2 to 2½ foot in diameter Russian thistle acted as a protection against rabbit damage. About 70 percent of the trees were thus protected.

(12) Mice girdled a number of juniper in the Denbigh arboretum in the winter of 1940-41 and it seemed that they must have worked just underneath the snow line (?) as the trees were girdled at from 1 to 10 inches above the ground line.

(13) In the W½ of SW of SW native chokecherry and white elm were girdled from the top of the trees to the ground line, apparently by porcupines.

(14) Juniper in clean cultivated seemed to be damaged more by winter injury (reflected in browning and dying back of the end 2 to 4 inches of new growth) than where a light weed cover was left. The weeds catch snow and reduce desiccating effect of the wind.

Precipitation Record at Denbigh in 1941

The year 1941 was an exceptionally good one as regards precipitation (table 11). Total precipitation for the 8 2/3 months for which a record was available, April 11 to December 31, 1941, was 21.51 inches and using the record for the first 3-1/3 months from Towner Nursery as applying to Denbigh, the year's precipitation amounted to 4.35 inches or a total of

Table 11.--Precipitation record at Denbigh, North Dakota for 1941 1/

Date	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1	T				.25	.10						
2			.30		2.75	.02			.04	.14		
3				.25	.50				1.55			
4				.42		.41			.58			
5					.18	.05	.10				.08	
6		T		.20	.05	.18		T		.47	.05	
7				.20	.05		.70		.85	.54		
8				.30			.35		.08			
9				.30	.25	.90		.27				
10			T	.01		.05		T				T
11			.10									.10
12					.15							T
13				.29	.40		T	.12				T
14				T	.23		.07	.12				
15	T		1.00	T	T				.30			
16						.08		.07				
17		T		T		.01				.02		
18					T	.38			.23			
19				.02	.14	.56		T	.61			
20		.02		.03	T	T		.10	.33		.05	
21	.40		.60	.12				.13	.02			
22				.02						.08	.06	
23		.05						.07	.66			
24	.20							.50	.13			
25					.42	.04		.01	T			
26			T		.12				.04			
27				.09	.95			.03				
28					.02	.27						
29					.02	.25		.26		.03		
30				.15	.15	T	.42	.62				
31					.09			T				
Total	.60	.07	2.00	2.38	6.72	3.28	1.64	2.30	5.42	1.21	.24	0
Normal	0.42	.44	.61	1.07	2.07	2.90	2.18	1.87	1.63	.97	.60	.46
Percent of normal	143	16	328	222	325	113	75	123	333	125	40	0

Total precipitation 1941 25.86. Total normal precipitation 15.22
Average percent of normal 170.

1/ Record from Jan. 1 to April 10, inclusive is from City of Towner Weather Bureau record.

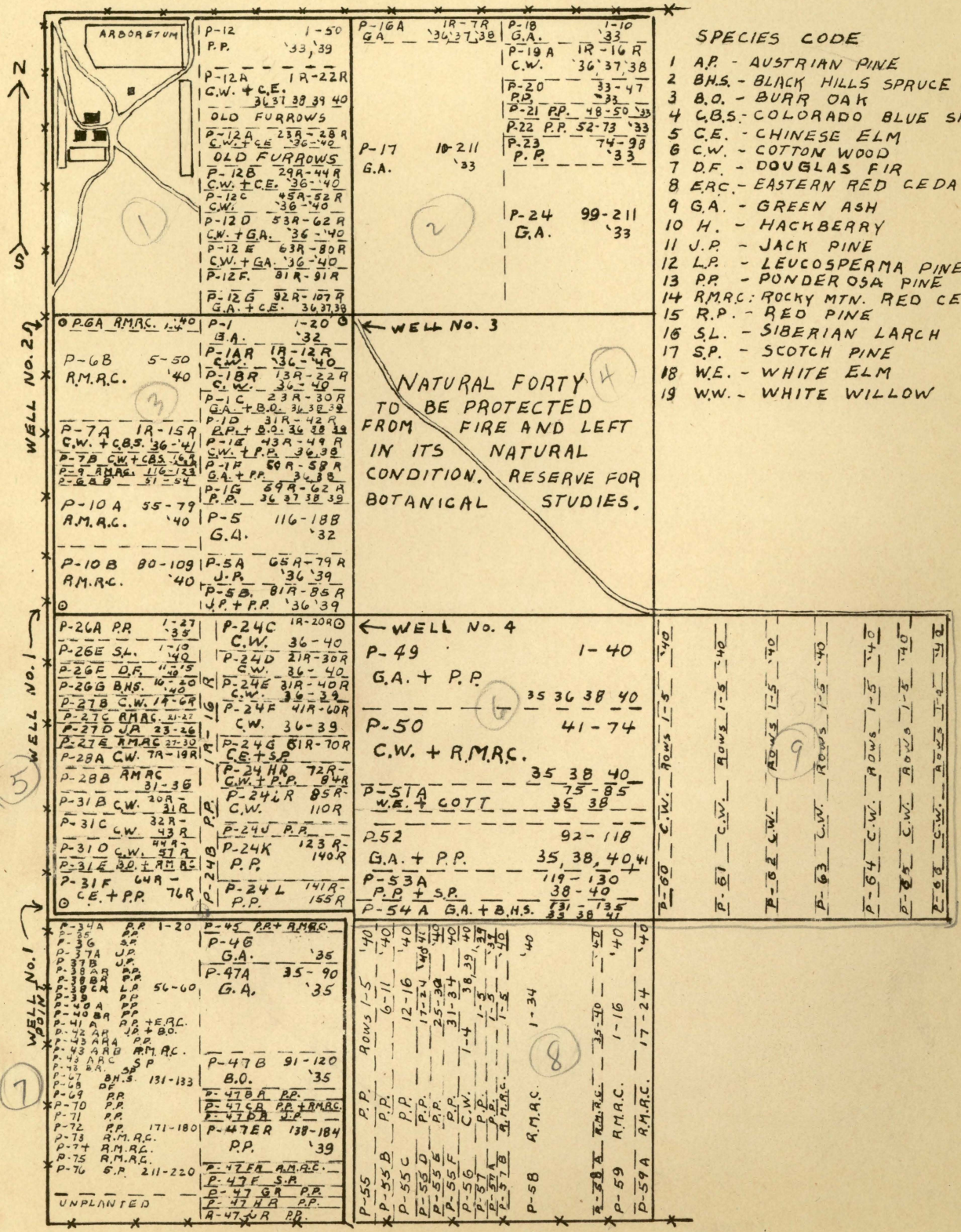
25.86 inches which is 170 percent of normal. Only in July and early August was there some semblance of a short drought from July 15 to 29 and from August 1 to 23 with one rain of .42 inches on July 30 to reduce its severity.

It is interesting to comment that even in a very exceptional year like 1941 the growth of cottonwood on 4 and 5 foot plowed strips was very mediocre and the conclusion was drawn that if there is a lot of rainfall, the soil moisture is rapidly reduced (1) by loss through under drainage, and more important (2) loss by use of moisture by weeds, grass, and competing vegetation in the adjoining unplowed strips.

It was the lack of good growth of cottonwood in 1940 and 1941 on such sites, contrasted with excellent results in the cross-cultivated trees, that clinched the decision to renovate some 140 acres of existing plantations in the fall of 1941.

STATUS OF EXPERIMENTAL PLANTING AT NORTHERN PLAINS BRANCH STATION, DENBIGH, N.D., AS OF APRIL 1, 1942

SEC. 36, T156 N, R. 78 W.


ARBORETUM
N
S
WELL NO. 2
WELL NO. 1
WELL NO. 3
WELL NO. 4
NATURAL FORTY TO BE PROTECTED FROM FIRE AND LEFT IN ITS NATURAL CONDITION. RESERVE FOR BOTANICAL STUDIES.
SCALE 1 INCH = 660 FEET

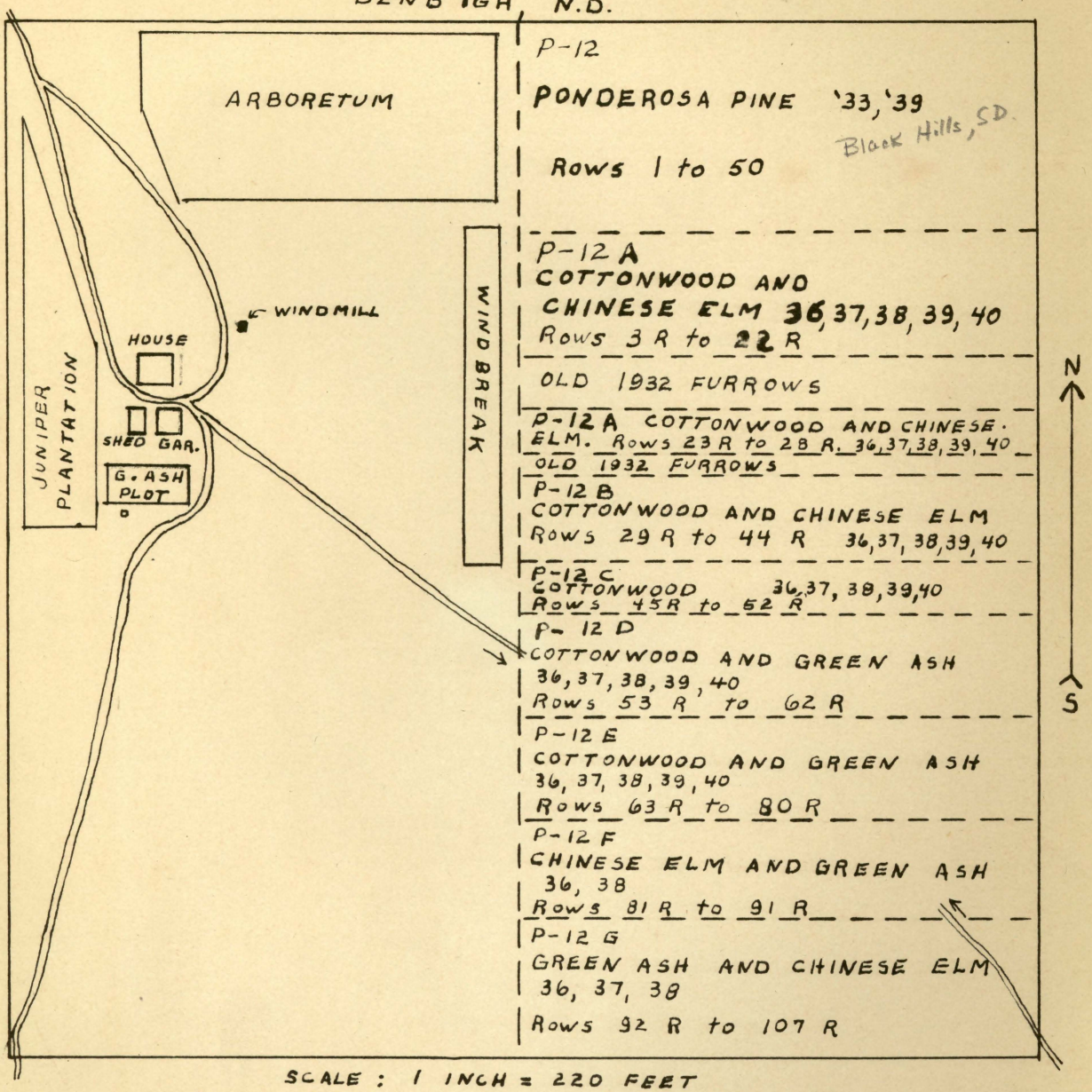
SPECIES CODE

1	A.P. - AUSTRIAN PINE
2	B.H.S. - BLACK HILLS SPRUCE
3	B.O. - BURR OAK
4	C.B.S. - COLORADO BLUE SPRUCE
5	C.E. - CHINESE ELM
6	C.W. - COTTON WOOD
7	D.F. - DOUGLAS FIR
8	E.R.C. - EASTERN RED CEDAR
9	G.A. - GREEN ASH
10	H. - HACKBERRY
11	J.P. - JACK PINE
12	L.P. - LEUCOSPERMA PINE
13	P.P. - PONDEROSA PINE
14	R.M.R.C. - ROCKY MTN. RED CEDAR
15	R.P. - RED PINE
16	S.L. - SIBERIAN LARCH
17	S.P. - SCOTCH PINE
18	W.E. - WHITE ELM
19	W.W. - WHITE WILLOW

DENBIGH PLANTATION STATUS, APRIL 1, 1942

(1)

E ½ OF N.W. OF N.W.
SEC. 36, T. 156 N., R. 78 W
DENBIGH, N.D.



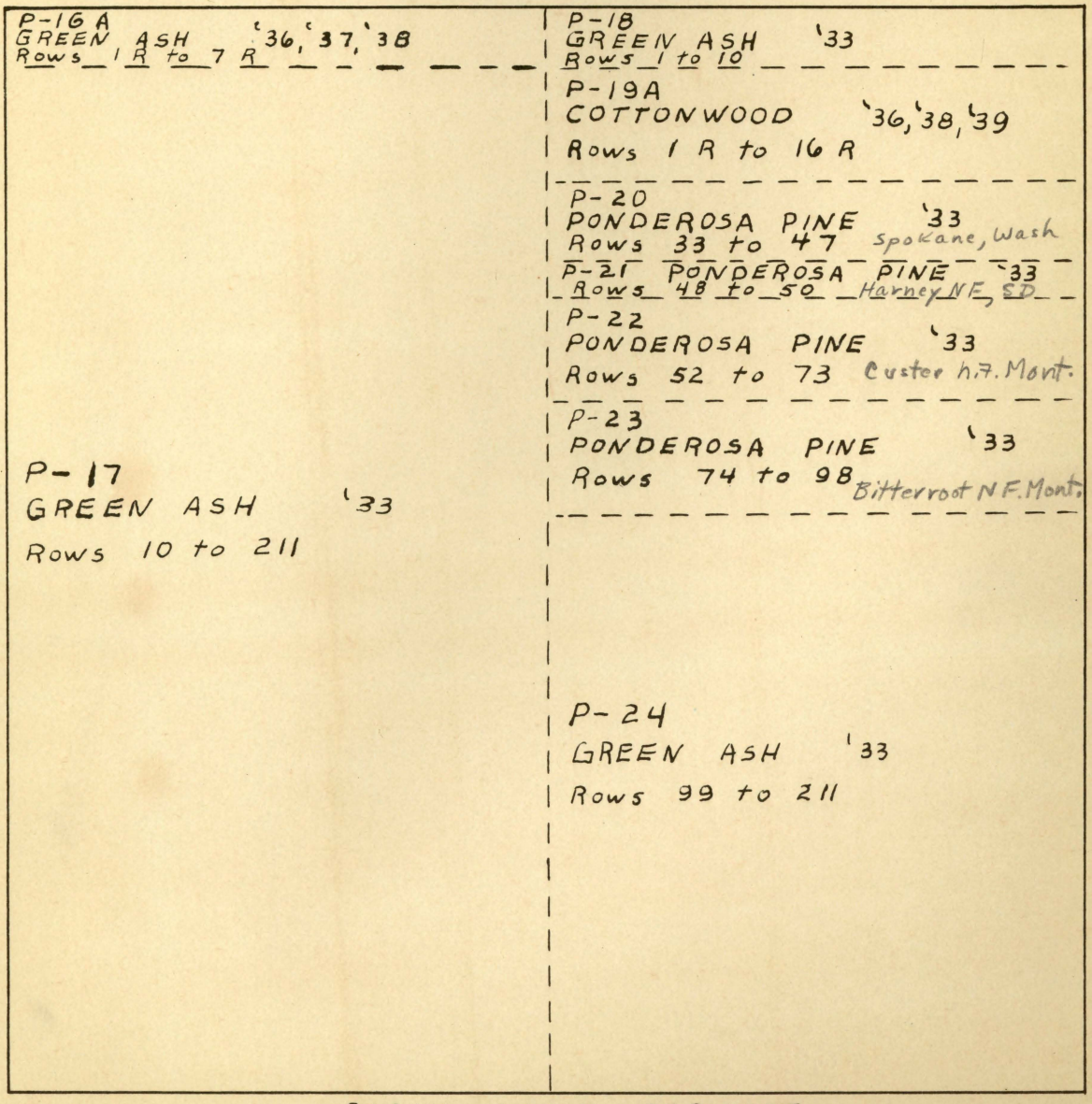
SCALE: 1 INCH = 220 FEET

(1)

DENBIGH PLANTATION STATUS
APRIL 1, 1942

NE OF NW SEC 36
T. 156 N., R. 78 W.
DENBIGH, N.D.

(2)



SCALE: 1 INCH = 220 FEET

DENBIGH PLANTATION STATUS
APRIL 1, 1942

(3)

S.W. OF N.W. SEC. 36
T. 156 N. R. 78 W.
DENBIGH, N.D.

WELL NO. 2 ⊙ ← WELL NO. 3 ⊙

P-6A J. SCOPULORUM '40
Rows 1 to 4

P-6B J. SCOPULORUM '40
Rows 5 to 50

P-7A '36, '37, '38, '40, '41
COTTONWOOD AND COLO. BLUE SPRUCE
Rows 1R to 15R

P-7B '36, '37, '38, '40, '41
COTTONWOOD AND COLO. BLUE SPRUCE
Rows 16R to 23R

P-9 J. SCOPULORUM '32
Rows 116 to 123

P-6BB J. SCOPULORUM '40
Rows 51 to 54

P-10A '40
J. SCOPULORUM
Rows 55 to 79

P-10B '40
J. SCOPULORUM
Rows 80 to 109

⊙ ← WELL NO. 1

P-1 '32
GREEN ASH
Rows 1 to 20

P-1AR '36, '37, '38, '40
COTTONWOOD
Rows 1R to 12R

P-1BR '36, '37, '38, '40
COTTONWOOD
Rows 13R to 22R

P-1C '36, '38, '39
GREEN ASH AND BURR OAK
Rows 23R to 30R

P-1D (Harney SD) '36, '38, '39
PONDEROSA PINE AND BURR OAK
Rows 31R to 42R

P-1E '36, '38 Harney
COTTONWOOD AND PONDEROSA PINE
Rows 43R to 49R

P-1F '36, '38 Harney
GREEN ASH AND PONDEROSA PINE
Rows 50R to 58R

P-1G '36, '37, '38, '39 Harney
PONDEROSA PINE
Rows 59R to 62R

P-5 '32
GREEN ASH
Rows 116 to 188

P-5A '36, '39
JACK PINE
Rows 65R to 79R

P-5B '36
JACK PINE AND PONDEROSA PINE Bl. Hills
Rows 81R to 85R

WELL NO. 4 →⊙

N ↑ S

SCALE: 1 INCH = 220 FEET

DENBIGH PLANTATION STATUS
April 1, 1942

(5)

NW OF SW OF SEC. 36
T. 156 N. - R. 78 W.
DENBIGH, N.D.

P-26A Harney N.F. '35
PONDEROSA PINE
Rows 1 to 27

P-26 E '40
SIBERIAN LARCH
Rows 1 to 10

P-26F DOUGLAS FIR '40, '41
Rows 11 to 15

P-26G BLACK HILLS SPRUCE '40
Rows 16 to 20

P-27 B COTTONWOOD '36, '37, '38, '40
Rows 1R to 6 R

P-27C J. SCOPULORUM '40 Rows 21-22

P-27D JACK PINE '40 Rows 23-26

P-27E J. SCOPULORUM '40
Rows 27 to 30

P-28 A '36, '37, '38, '40
COTTONWOOD
Rows 7R to 19 R

P-28 B '40
J. SCOPULORUM
Rows 31 to 36

P-31 B '36, '37, '38, '40
COTTONWOOD
Rows 20 R to 31 R

P-31 C '36, '37, '38, '40
COTTONWOOD
Rows 32 R to 43 R

P-31 D '36, '37, '38, '40
COTTONWOOD
Rows 44 R to 57 R

P-31E '36, '37, '39
BURR OAK AND J. SCOPUL'ORUM
Rows 58 R to 63 R

P-31 F '36, '37, '38
CHINESE ELM AND
PONDEROSA PINE Harney S.D.
Rows 64 R to 76 R

P-24 B '36, '37 Custer Mont.
PONDEROSA PINE
Rows 1 R to 16 R

P-24 C '36, '37, '38, '39, '40
COTTONWOOD
Rows 1R to 20R

P-24D '36, '37, '38, '39, '40
COTTONWOOD
Rows 21 R to 30 R

P-24E '36, '37, '38, '39
COTTONWOOD
Rows 31 R to 40 R

P-24F '36, '37, '38, '39
COTTONWOOD
Rows 41R to 60 R

P-24 G '36 '37 '38
CHINESE ELM AND SCOTCH
PINE Rows 61R to 70 R

P-24 HR '36, '38, '39 '41
COTTON WOOD AND PONDEROSA
PINE Rows 72 R to 84 R

P-24 iR '36 '38
COTTONWOOD
Rows 85 R to 110 R

P-24 J '36, '37 Custer +
PONDEROSA PINE
Rows 111 R to 122 R Harney

P-24 K '36, '37, '38
PONDEROSA PINE Harney
Rows 123 R to 140 R

P-24 L '36, '37
PONDEROSA PINE Custer
Rows 141 R to 150 R

N
S
Fallon, Mont.

TRUCK TRAIL

TRUCK TRAIL

SCALE : 1 INCH = 220 FEET

DENBIGH PLANTATION STATUS
APRIL 1, 1942

(6)

N.E. OF SW OF SEC. 36
T. 156 N., R. 78 W.
DENBIGH, N.D.

'35, '36, '38, '40
P-49 GREEN ASH AND PONDEROSA PINE (Custer, SD.
Rows 1 to 40

'35, '38, '40
P-50 COTTONWOOD AND J. SCOPULORUM
Rows 41 to 74

P-51A WHITE ELM AND COTTONWOOD '35 '38
Rows 75 to 85

P-51 WHITE ELM '35
Rows 86 to 91

'35, '38, '40 '41
P-52 GREEN ASH AND PONDEROSA PINE (Custer, SD.
Rows 92 to 118

Harney NF
P-53A PONDEROSA AND SCOTCH PINE '38, '40
Rows 119 to 130

P-54A GREEN ASH AND BLACK HILLS SPRUCE '35, '38, '41
Rows 131 to 135

N
S

SCALE: 1 INCH = 220 FEET

DENBIGH PLANTATION STATUS, APRIL 1, 1942

(7)

S.W. OF S.W. OF SEC. 36
T. 156 N., R. 78 W.
DENBIGH, N.D.

P-34A PONDEROSA PINE '39
Rows 1-20 Glendive, Mont.

P-35 PONDEROSA PINE '35
Rows 21 to 30 Bitterroot, Mont.

P-36 SCOTCH PINE Michigan '34
Rows 31 to 38 Rigs

P-37A JACK PINE '35
Rows 39 to 43 Mich.

P-37B JACK PINE Rows 44-49 N.D. '35

P-38 AR PONDEROSA P. Rows 50-53 '35, '39 ← Harney N.F.

P-38 BR PONDEROSA P. Rows 54-55 '39 ← W. Nebr.

P-38 CR P. LEUCOSPERMA Rows 56-60 '39 ← Japan

P-39 PONDEROSA P. Rows 61-72 '35 ← Custer, Mont.

P-40A PONDEROSA P. Rows 73-76 '35 ← Bitterroot, Mont.

P-40BR PONDEROSA P. Rows 77-82 '39 ← Jordan, Mont.

P-41A PONDEROSA P. and PLATTE RIVER JUNIPER Rows 83-90 '35, '39 ← Nebr.

P-42 AR JACK PINE and BURR OAK Rows 91-100 '35, '38, '39 ← Minn.

P-43 ARA PONDEROSA PINE '38, '39
Rows 101-110 Fallon, Mont.

P-43 ARB J. SCOPULORUM '38, '39
Rows 111-120 N.D.

P-43 ARC SCOTCH PINE '38
Rows 121-130 Minn.

P-43 BR SCOTCH PINE Rows 131-132 '38 Wis.

P-67 BLACK HILLS SPRUCE Rows 133-138 '41

P-68 DOUGLAS FIR Rows 139-140 '41

P-69 PONDEROSA PINE '41
Rows 141-150 Fallon, Mont.

P-70 PONDEROSA PINE '41
Rows 151-160 Bl. Hills, S.D.

P-71 PONDEROSA PINE '41
Rows 161-170 Fallon, Mont.

P-72 PONDEROSA PINE '41
Rows 171-180 Custer, S.D.

P-73 J. SCOPULORUM '41
Rows 181-190

P-74 J. SCOPULORUM '41
Rows 191-200

P-75 J. SCOPULORUM '41
Rows 201-210

P-76 SCOTCH PINE '41
Rows 211-220

Unplanted

P-45 PONDEROSA PINE AND PLATTE RIVER JUNIPER Rows 1-4 '34, '39 ← Nebr.

P-46 GREEN ASH '34
Rows 5 to 34

P-47A GREEN ASH '35
Rows 35 to 90

P-47B BURR OAK '35
Rows 91 to 120

P-47BR PONDEROSA PINE '39
Rows 121 to 130 Glendive, Mont.

P-47 CR J. SCOPULORUM AND PONDEROSA PINE Rows 131-132 '36, '39 ← Nebr.

P-47 DR JACK PINE '39
Rows 133-137

P-47 ER PONDEROSA PINE '39
Rows 138 to 184
Fallon, Mont.

P-47 FR J. SCOPULORUM Rows 185-186 '41

P-47F SCOTCH PINE '36
Rows 187 to 200

P-47 GR PONDEROSA PINE '39 ← Glendive, Mont.
Rows 201 to 210

P-47 HR PONDEROSA PINE 211 Rows 212, 213 '39 ← Fallon "

P-47 JR PONDEROSA PINE 214 Rows 215, 216 ← Glendive "

N

S

SCALE: 1 INCH = 220 FEET

DENBIGH PLANTATION STATUS
APRIL 1, 1942

SE. OF S.W. OF SEC. 36
T. 156 N. R. 78 W.
DENBIGH, N.D.

(8)

P-55	PONDEROSA PINE	Rows 1 to 5	1940
P-55 B	PONDEROSA PINE	Rows 6 to 11	1940
P-55 C	PONDEROSA PINE	Rows 12 to 16	1940
P-55 D	PONDEROSA PINE	Rows 17 to 24	1940, 1941
P-55 E	PONDEROSA PINE	Rows 25 to 30	1940
P-55 F	PONDEROSA PINE	Rows 31 to 34	1940
P-56	COTTONWOOD	Rows 1 to 4	'38, '39, '40
	UNPLANTED		
P-57	PONDEROSA PINE	Rows 1 to 5	1939
	UNPLANTED		
P-57 A	PONDEROSA PINE	Rows 1 to 5	1939
	UNPLANTED		
P-57 B	J. SCOPULORUM	Rows 1 to 5	1940
P-58	J. SCOPULORUM	Rows 1 to 34	1940
P-58 A	J. SCOPULORUM	Rows 35 to 40	1940
P-59	J. SCOPULORUM	Rows 1 to 16	1940
P-59 A	J. SCOPULORUM	Rows 17 to 24	1940

Fallon, Mont.
Glendive, "
Jordan "
Bl. Hills SD
W. Nebr.
Custer, SD
W. Nebr.
Glendive, Mont.
Bl. Hills SD
Butte Cr, Mont.

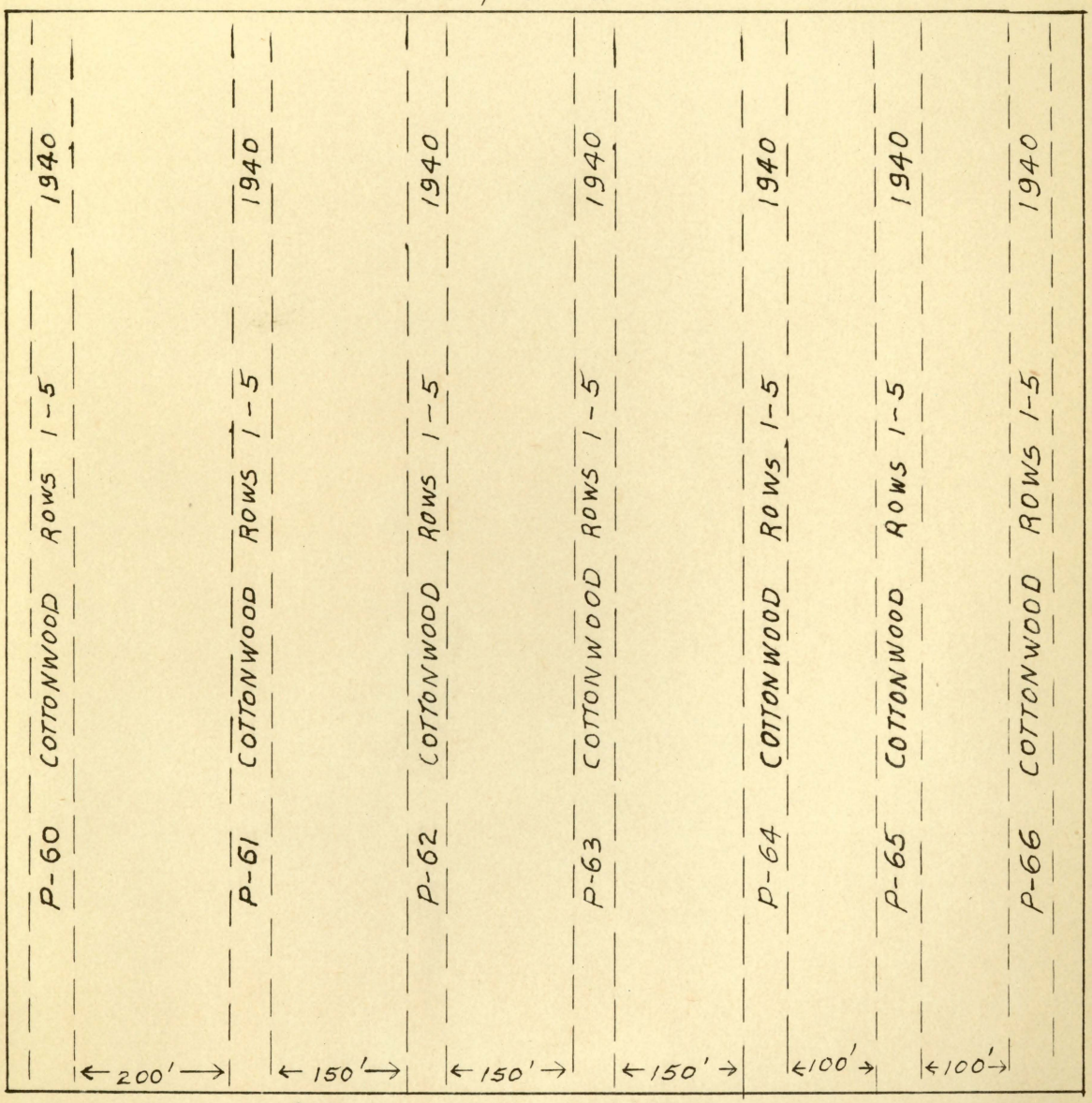
SCALE : 1 INCH = 220 Feet

S → N

DENBIGH PLANTATION STATUS
APRIL 1, 1942

(9)

N.W. OF S.E. OF SEC. 36
T. 156 N., R. 78 W.
DENBIGH, N. DAK.



SCALE: 1 INCH = 220 FEET

AS OF APRIL 1, 1942 THE 100 TO 200-FOOT-WIDE STRIPS BETWEEN THE COTTONWOOD STRIPS WERE VIRGIN PRAIRIE GRASS.

Denbigh plantation status on April 1, 1942 in NW of SE of Sec. 36

Location	No. rows	Assigned row No.	Planta-tion No.	Age of stock	Species	Date planted and replanted	Total No. trees in planta-tion	Trees alive fall 1941	Percent of count 1941	Survival fall 1941	Seed source	Average height fall 1941
										Percent		Inches
NW of SE	5	1 to 5	60	1-1	Cottonwood	40	775	587	100	75.7	Bismarck, N. D.	61
	5	1 to 5	61	1-1	Cottonwood	40	770	573	100	74.4	Bismarck, N. D.	63
	5	1 to 5	62	1-0	Cottonwood	40	790	749	100	94.8	Mandan, N. D.	76
	5	1 to 5	63	1-0	Cottonwood	40	780	747	100	95.8	Mandan, N. D.	87
	5	1 to 5	64	1-0	Cottonwood	40	760	724	100	95.3	Mandan, N. D.	72
	5	1 to 5	65	1-0	Cottonwood	40	745	686	100	92.1	Mandan, N. D.	92
	5	1 to 5	66	1-0	Cottonwood	40	770	709	100	92.1	Mandan, N. D.	78

Average Temperatures
1941
Denbigh, North Dakota

Month	10-day period	Average temperatures Degrees F. Mean	Max.	Min.	No. of observations	Extreme temperature Degrees F. Maximum	Minimum	Average daily range Degrees F.
April	1	-	-	-	0	-	-	-
	2	43.0	53.6	32.6	9	-	-	21.1
	3	49.8	62.6	37.0	10	-	-	25.6
	Month	46.6	58.3	34.9	19	80.0	21.0	23.4
May	1	54.0	63.2	44.7	10	-	-	18.5
	2	59.2	71.8	46.7	10	-	-	25.1
	3	56.6	67.8	45.4	11	-	-	22.5
	Month	56.6	67.6	45.6	31	94.0	28.0	22.0
June	1	54.6	62.5	46.6	10	-	-	15.9
	2	64.4	77.7	51.1	10	-	-	26.6
	3	71.8	84.1	59.6	10	-	-	24.5
	Month	63.6	74.8	52.4	30	93.0	41.0	22.3
July	1	64.4	75.8	53.0	6	-	-	22.8
	2	65.6	80.1	51.0	10	-	-	29.1
	3	75.7	90.7	60.7	11	-	-	30.0
	Month	69.5	83.6	55.4	27	95.0	39.0	28.9
Aug.	1	73.8	87.4	60.1	10	-	-	27.3
	2	65.0	78.5	51.5	10	-	-	27.0
	3	61.0	73.2	48.8	11	-	-	24.5
	Month	66.4	79.5	53.3	31	102.0	42.0	26.2
Sept.	1	58.0	69.1	46.8	10	-	-	22.3
	2	58.4	72.8	43.9	10	-	-	28.9
	3	43.2	53.0	33.4	10	-	-	19.6
	Month	53.2	65.0	41.4	30	90.0	25.0	23.6

Soil Temperatures at Depth of Four Feet
1941
Denbigh, North Dakota

Month	10-day period	Station No. 1 (in open)		Station No. 2 (under aspen clump)	
		No. of observations	Average temperature Degrees F.	No. of observations	Average temperature Degrees F.
April	1	0		0	
	2	7	34.8	4	34.0
	3	9	41.7	4	39.7
	Month	16	38.6	8	36.9
May	1	9	49.7	5	45.6
	2	9	51.9	4	48.5
	3	11	55.7	4	50.8
	Month	29	52.6	13	48.1
June	1	9	56.0	5	51.6
	2	10	58.0	4	52.4
	3	10	64.9	5	55.0
	Month	29	59.8	14	53.0
July	1	7	65.9	2	57.0
	2	8	65.2	4	57.0
	3	11	67.4	6	58.2
	Month	26	66.3	12	57.6
August	1	9	67.3	3	59.7
	2	9	65.8	4	59.2
	3	11	63.0	3	58.2
	Month	29	65.0	10	59.0
September	1	10	61.4	2	57.2
	2	10	58.6	0	-
	3	10	56.2	1	50.5
	Month	30	58.7	3	55.0

Wind Movement at Station No. 1
1941
Denbigh, North Dakota

Date	Average miles per hour					
	April	May	June	July	August	September
1		7.8 8.0	9.0	11.3	4.7	23.8 3
2		10.5	7.0	3.8	3.8 9	16.8 9
3		11.0	4.8	5.2	4.7	30.4
4		7.3	3.3	-	14.2	8.7
5		13.5	7.3	-	13.3	9.2
6		9.1	12.1	-	10.1	14.3
7		23.6	17.7	-	8.7	8.8
8		18.9	8.5	9.7	4.4	14.4
9		6.5	10.0	8.7	6.7	5.4
10		5.0	10.3	3.8	6.9	5.0
11		8.0	8.1	3.4	7.5	7.1
12	13.3	7.3	12.5	3.9	7.4	17.1
13	9.8	15.8	9.0	5.8	5.0	11.0
14	7.0	10.3	5.4 5	7.2	13.5	8.4
15	9.0	6.3 4	2.8	2.5	5.2	6.0
16	8.8	6.0	5.8	3.6	5.9	7.9
17	5.2 3	8.2	8.2	8.3	11.5	8.6
18	6.4	3.0 2.9	8.8	7.9	13.4	7.5
19	11.7	24.7	8.2	8.8	6.2 3	7.7
20	9.3	9.8	7.8	10.0	7.6	11.4
21	11.1	9.1	5.8	7.5	4.6	10.4 5
22	9.5	10.4	5.9	7.1	6.5	10.4
23	10.4	11.1	5.0	6.2	5.8	7.2
24	9.5	9.4	12.5	7.6	10.2	8.8
25	8.3	3.5	15.1 3	7.6	9.3	9.2 3
26	7.1	20.2	11.3	11.1	6.4	9.9
27	4.9	11.3	4.0	10.3	5.9	12.0
28	13.2 9	10.7	6.8	6.6	9.6	8.9
29	11.6	5.7	7.3	5.9	4.9	8.5
30	10.1	7.7	4.0	6.8	7.5	10.8
31	-	9.4	-	6.0	5.9	-
Month	9.2	10.6	8.2	6.9	7.6	10.8

Note: Average miles per hour refer to readings as of 8:00 a.m. for preceding 24-hour period. In reality, most of the mileage was accumulated on the day preceding the date of recording.

Denbigh plantation status on April 1, 1942 in W½ SW of ~~NW~~ SW of Sec. 36

Location	No. rows	Assigned row No.	Planta-tion No.	Age of stock	Species	Date planted and replanted	Total No. trees in planta-tion	Trees alive fall 1941	Percent of count 1941	Survival fall 1941	Col. No.	Seed source	Average height fall 1941
										Percent			Inches
W½ SW SW (7)	20	1 to 20	34A	2-2	Ponderosa pine	1939	3356	361	25	43.0	364	Glendive, Mont.	8
	5	21 to 25	35	1-1-1	Ponderosa pine	1934	882	256	100	29.0		Bitterroot For.,Mont.	15
	3	26 to 28	35	1-1-1	Ponderosa pine	1934	533	47	100	8.8		Bitterroot F.,Mont.	10
	2	29 and 30	35	1-1-1	Ponderosa pine	1934	335	22	100	0.9		Bitterroot F.,Mont.	13
	10	21 to 30	35	1-1-1	Ponderosa pine	1934	1750	325	100	18.6		Bitterroot F.,Mont.	13
	3	31 to 33	36	2-1	Scotch pine	1934	537	15	100	2.8	253	Tawas City, Mich.	13
	2	34 and 35	36	2-1	Scotch pine	1934	356	2	100	0.8	253	Tawas City, Mich.	15
	2	36 and 37	36	2-1	Scotch pine	1934	351	3	100	0.9	127	Authentic Riga	22
	1	38	36	2-1	Norway pine	1934	176	0	100	0.0	173		--
	3	39 to 41	37A	2-0	Jack pine	1935	533	24	100	4.5	302	Solway, Minn.	21
	2	42 and 43	37A	2-0	Jack pine	1935	349	9	100	2.6	302	Solway, Minn.	17
	6	44 to 49	37B	2-0	Jack pine	1935	1056	12	50	2.3	275	McPhid Ranch, Towner,N.D.	13
	4	50 to 53	38AR	1-1 and 2-2	Ponderosa pine	1935,1939	530	186	60	52.2	376	Harney NF, S.D.	8
	2	54 and 55	38BR	2-2	Ponderosa pine	1939	343	111	100	32.4	380	Western Nebr.	10
	5	56 to 60	38CR	3-2	Pinus leucosperma	1939	880	17	40	4.8	289	Kujo Chosen,Japan	8
	12	61 to 72	39	1-1	Ponderosa pine	1935	2128	85	33.33	12.0		Custer NF,Mont.	10
	4	73 to 76	40A	1-1	Ponderosa pine	1935	713	23	50	6.5		Bitterroot NF,Mont.	11
	6	77 to 82	40BR	2-2	Ponderosa pine	1939	1048	35	33.33	10.0	365	Jordan, Mont.	10
	8	83 to 90	41A	2-2	Ponderosa pine	1939	1286	74	37.5	15.4	380	Western Nebraska	7
	8	83 to 90	41A	3-0	Platte River juniper	1935	1416	57	37.5	10.7		Nebraska	17
	10	91 to 100	42AR	2-1	Jack pine	1938,1939	1789	101	30	20.7	372	Chippewa NF,Minn.	13
	10	91 to 100	42AR	1-0	Burr oak	1935	1778	8	30	0.9	320	Pleasant Lake,N.D.	9
	10	101 to 110	43ARA	2-1 and 2-2	Ponderosa pine	1938,1939	1799	207	30	38.4	363	Fallon, Mont.	7
	10	111 to 120	43ARB	2-1 and 3-2	J. scopulorum	1938,1939	1781	158	30	29.6	317	Watford City,N.D.	8
	10	121 to 130	43ARC	2-1	Scotch pine	1938	1782	4	20	1.1	331	Rochester,Minn.	10
	2	131 and 132	43BR	2-2	Scotch pine	1938	326	2	100	5.5	259A	Cochrane, Wis.	9
	6	133 to 138	67	3-4	Black Hills spruce	1941	1058	442	50	41.8	330	Black Hills,S.D.	Est.8
	2	139 and 140	68	4-2	Douglas fir	1941	357	87	100	24.5	377	Region 1, USFS	Est.8
	5	141 to 145	69	2-1	Ponderosa pine	1941	887	817	100	92.1	438	Fallon, Mont.	4
	5	146 to 150	69	2-1	Ponderosa pine	1941	935	813	100	87.0	438	Fallon, Mont.	5
	5	151 to 155	70	2-0	Ponderosa pine	1941	912	591	100	64.9	376	Black Hills, S.D.	4
	5	156 to 160	70	2-0	Ponderosa pine	1941	894	379	100	42.4	376	Black Hills, S.D.	4
	5	161 to 165	71	2-2	Ponderosa pine	1941	854	579	100	67.8	363	Fallon, Mont.	8
	5	166 to 170	71	2-2	Ponderosa pine	1941	863	464	100	53.8	363	Fallon, Mont.	8
	5	171 to 175	72	3-2	Ponderosa pine	1941	895	828	100	85.2	397	Custer, S.D.	8
	5	176 to 180	72	3-2	Ponderosa pine	1941	900	898	100	84.2	397	Custer, S.D.	8
	5	181 to 185	73	2-1	J. scopulorum	1941	903	897	100	99.2	403		7
	5	186 to 190	73	2-1	J. scopulorum	1941	884	837	100	94.7	403		7
	5	191 to 195	74	2-0	J. scopulorum	1941	905	868	100	95.9	437		5
	5	196 to 200	74	2-0	J. scopulorum	1941	883	695	100	78.7	437		8
	5	201 to 205	75	2-2	J. scopulorum	1941	884	863	100	97.6		Medora, N. D.	13
	5	206 to 210	75	2-2	J. scopulorum	1941	911	885	100	97.1		Medora, N. D.	13
	5	211 to 215	76		Scotch pine	1941	826	439	100	53.1	385		7
	5	216 to 220	76		Scotch pine	1941	841	335	100	39.8	385		8

Monthly Wind Movement
1941
Denbigh, North Dakota

Month	Total movement for month	Ave. 24-hour movement: Total miles	Ave. 24-hour movement: M.P.H.	Greatest 24-hour movement: Date	Greatest 24-hour movement: Total miles	Greatest 24-hour movement: M.P.H.	Smallest 24-hour movement: Date	Smallest 24-hour movement: Total miles	Smallest 24-hour movement: M.P.H.	Greatest 3-day movement: Date	Greatest 3-day movement: Total miles	Greatest 3-day movement: M.P.H.	Actual hours in 3-day period
April	4168.5	220.8	9.2	28	331.2*	13.8	27	117.7	4.9	28-30	842.3	11.9	71.0
May	7863.9	254.4	10.6	19	592.8*	24.7	18	72.0*	3.0	6-8	1244.9	17.1	72.5
June	5865.4	196.8	8.2	7	424.8*	17.7	15	67.2*	2.8	6-8	936.0	12.7	73.5
July	4476.3	165.6	6.9	1	271.0	11.3	15	59.8	2.5	25-27	714.0	9.7	73.5
Aug.	5696.0	182.4	7.6	4	340.8*	14.2	2	92.5	3.8	4-6	888.8	12.5	71.0
Sept.	7773.2	259.2	10.8	3	728.5	30.4	10	119.9	5.0	1-3	1664.6	23.4	71.0

Note - Totals marked * are computed.

Total miles recorded refer to the previous 24-hour period, but recorded for date of reading.

Grams of Evaporation from Bates Evaporimeter - Type 6
1941
Denbigh, North Dakota

Month	Period From	Period To	No. of days	Station No. 1 (on 5-foot pole) Evap. No.	Wt. out	Wt. in	Total	Ave.	Station No. 2 (on ground) Evap. No.	Wt. out	Wt. in	Total	Ave.
April	4/11	4/26	15	492	1245.7	700.5	545.2	36.3	452	1245.3	952.4	292.9	19.5
	4/26	5/1	5	452	1319.6	1087.9	231.7	46.3	492	1311.3	1166.0	145.3	29.0
	Period		20				776.9	38.8				438.2	21.9
May	5/1	5/10	9	492	1312.3	741.6	570.7	63.4	452	1307.7	1054.9	252.8	28.0
	5/10	5/19	9	452	1310.9	715.7	595.2	66.2	492	1311.7	992.2	319.5	35.5
	5/19	5/26	7	492	1313.3	781.8	531.5	75.8	452	1306.0	1031.9	274.1	39.2
	5/26	6/2	7	452	1314.6	1167.2	147.4	21.0	492	1314.6	1235.6	79.0	11.3
	Period		32				1844.8	57.6				925.4	28.9
June	6/2	6/16	14	492	1310.5	754.9	555.6	39.6	452	1307.5	1055.0	252.5	18.0
	6/16	6/23	7	452	1317.1	863.6	453.5	64.8	492	1319.7	1003.9	315.8	45.1
	6/23	7/1	8	492	1322.0	730.0	592.0	74.0	452	1317.4	980.4	337.0	42.1
	Period		29				1601.1	55.2				905.3	31.2
July	7/1	7/9	8	452	1322.0	876.7	445.3	55.7	492	1311.5	1030.7	280.8	35.1
	7/9	7/19	10	492	1324.5	755.5	569.0	56.9	452	1334.5	1056.4	278.1	27.8
	7/19	7/24	5	452	1323.0	812.4	510.6	102.1	492	1318.3	984.1	334.2	66.8
	7/24	7/30	6	492	1315.7	785.8	529.9	88.3	452	1320.3	1026.3	294.0	49.0
	Period		29				2054.8	70.8				1187.1	41.0
Aug.	7/30	8/6	7	452	1328.3	837.4	490.9	70.1	492	1329.5	1006.6	322.9	46.1
	8/6	8/15	9	492	1325.3	816.1	509.2	56.6	452	1325.4	1089.4	236.0	26.2
	8/15	8/23	8	452	1313.2	831.8	481.4	60.1	492	1320.4	1024.1	296.3	37.0
	8/23	9/1	9	492	1318.1	911.9	406.2	45.2	452	1314.5	1096.6	217.9	24.2
	Period		33				1887.7	57.2				1073.1	32.5
Sept.	9/1	9/12	11	452	1320.0	835.3	484.7	44.1	492	1309.4	1030.8	278.6	25.4
	9/12	9/23	11	492	1327.3	1139.7	187.6	17.0	452	1317.4	1328.1	(132.0)*	12.0
	9/23	10/1	8	452	1581.1	1079.5	501.6	60.6	492	1540.0	1114.6	425.4	53.2
	Period		30				1173.9	39.1				836.0	27.8
	Total		173				9339.2	54.0				5365.1	31.0

* Figures in parenthesis are estimated.

Denbigh plantation status on April 1, 1942 in NW of NW and NE of NW of Sec. 36

Location	No. rows	Assigned row No.	Planta-tion No.	Age of stock	Species	Date planted and replanted	Total No. trees in planta-tion	Trees alive fall 1941	Percent of count 1941	Survival count 1941	Seed source	Average height fall 1941
										Percent		Inches
E½ NW NW (1)	50	1 to 50	12	2-1	Ponderosa pine	1933,1939	6114	589	30	32.1	Black Hills, S.D.	11
	13	3R, 5R to 27R	12A	1-0	Cottonwood	1936,1937, '38,'39,'40	1507	1155	100	76.6	Bismarck, N.D.	34
	13	4R, 6R to 28R	12A	1-0	Chinese elm	'36,'37,'38	1199	975	100	81.5	Shelterbelt Proj.	47
	8	29R,30R,33R,34R,37R,38R, 41R, 42R	12B	1-0	Cottonwood	1936,1937 '38,'39,'40	881	670	100	76.1	Bismarck, N.D.	25
	8	31R,32R,35R,36R,39R,40R, 43R, 44R	12B	1-0	Chinese elm	'36,'37,'38	788	545	100	69.2	Shelterbelt Proj.	36
	8	45R to 52R	12C	1-0	Cottonwood	1936, 1937 '38,'39,'40	908	347	50	76.4	Bismarck, N.D.	34
	5	53R, 55R to 61R	12D	1-0	Cottonwood	1936, 1937 '38,'39,'40	564	177	40	78.5	Bismarck, N.D.	28
	5	54R, 56R to 62R	12D	3-0	Green ash	'36,'37,'38	503	132	40	65.8	Bottineau, N.D.	27
	10	63R,64R,67R,68R to 79R, 80R	12E	1-0	Cottonwood	1936, 1937 '38,'39,'40	1074	390	50	72.6	Bismarck, N. D.	45
	8	65R, 66R, 69R, 70R, 73R, 74R, 77R, 78R	12E	3-0	Green ash	1936, 1938	756	287	50	75.9	Bottineau, N.D.	15
	6	81R, 83R to 91R	12F	1-0	Chinese elm	'36,'37,'38	584	220	50	75.3	Shelterbelt Proj.	37
	5	82R, 84R to 90R	12F	3-0	Green ash	1936, 1938	470	222	60	78.7	Bottineau, N. D.	23
	8	92R, 93R, 96R, 97R, 100R, 101R,104R,105R	12G	3-0	Green ash	1936, 1938	774	295	50	63.1	Bottineau, N. D.	26
	8	94R, 95R, 98R, 99R, 102R, 103R, 106R, 107R	12G	1-0	Chinese elm	'36,'37,'38	802	304	50	75.8	Shelterbelt Proj.	43
W½ NE NW (2)	7	1R to 7R	16A	3-0	Green ash	'36,'38,'39	813	262	42.9	61.1	Bottineau, N. D.	26
	17	10 to 211	17	2-0	Green ash	1933	23,313	69	3.98	7.4	Bottineau, N. D.	8
E½ NE NW (2)	10	1 to 10	18	2-0	Green ash	1933	1780	76	30	14.2	Bottineau, N. D.	8
	16	1R to 16R	19A	1-0	Cottonwood	'36,'38,'39	2287	26	18.75	6.1	Bismarck, N. D.	35
	15	33 to 47	20	1-2	Ponderosa pine	1933	1964	0	20	0.0	Spokane, Wash.	--
	3	48 to 50	21	2-1	Ponderosa pine	1933	532	10	66.67	2.8	Harney N.F.,S.D.	10
	22	52 to 73	22	1-1	Ponderosa pine	1933	2944	25	18.2	4.7	Custer N.F.,Mont.	18
	25	74 to 98	23	1-1	Ponderosa pine	1933	3406	45	20	6.6	Bitterroot NF,Mont.	16
	113	99 to 211	24	2-0	Green ash	1933	10,093	27	5.31	5.0	Bottineau, N. D.	7

Denbigh plantation status on April 1, 1942 in SW of NW of Sec. 36

Location	No. rows	Assigned row No.	Planta-tion No.	Age of stock	Species	Date planted and replanted	Total No. trees in planta-tion	Trees alive fall 1941	Percent of count 1941	Survival count 1941	Seed source	Average height fall 1941	Col. No.
									Percent			Inches	
B½ SW NW (3)	20	1 to 20	1	2-0	Green ash	1932	2660	190	20	35.7	Bottineau, N.D.	19	
	12	1R to 12R	1AR	1-0	Cottonwood	1936,1937, '38, '40	1493	118	25	31.6	Bismarck, N. D.	28	
	10	13R to 22R	1BR	1-0	Cottonwood	1936,1937 '38, '40	1221	189	30	51.6	Bismarck, N. D.	21	
	4	23R, 25R, 27R, 29R	1C	3-0	Green ash	1936,1938	376	146	50	78.7	North Dakota	17	
	4	24R, 26R, 28R, 30R	1C	1-0	Burr oak	1936,1939	527	74	50	28.1	Pleasant Lake,N.D.	6	
	6	32R, 34R to 41R	1D	1-0	Burr oak	1936,1939	1055	182	50	34.5	Pleasant Lake,N.D.	7	
	6	31R, 33R to 42R	1D	2-1	Ponderosa pine	1936,1938	575	195	50	67.8	Harney N.F.,S.D.	9	
	4	43R, 45R, 47R	1E	1-0	Cottonwood	1936,1938	715	86	100	12.0	Bismarck, N.D.	31	
	3	44R, 46R, 48R	1E	2-1	Ponderosa pine	1936,1938	345	216	100	62.6	Harney N.F.,S.D.	11	
	5	50R, 52R to 58R	1F	3-0	Green ash	1936,1938	449	320	100	71.3	Bottineau, N.D.	16	
	4	51R, 53R to 57R	1F	2-1	Ponderosa pine	1936,1938	353	196	100	55.5	Harney N.F.,S.D.	14	
	4	59R, 60R, 61R, 62R	1G	2-1	Ponderosa pine	1936,1937, 1938,1939	457	222	100	48.6	Harney N.F.,S.D.	10	
	[illegible]	116 to 188	5	2-0	Green ash	1932	8257	192	9.6	14.0	Bottineau,N.D.	6	
	16	65R to 80R	5A	2-2	Jack pine	1936,1939	1834	197	31.25	34.4	Chippewa NF,Minn.	15	
	5	81R to 85R	5B	2-2	Jack pine	1939	694	65	100	9.4	Chippewa NF,Minn.	16	
	5	81R to 85R	5B	2-0	Ponderosa pine	1936	649	36	100	5.6	Black Hills,S.D.	9	
W½ SW NW	4	1 to 4	6A	3-2	J. scopulorum	1940	498	434	100	87.1	Medora, N.D.	17	317
	46	5 to 50	6B	2-2	J. scopulorum	1940	6015	1210	21.73	92.6	Medora, N.D.	13	361
	9	1R, 3R to 13R,14R,15R	7A	1-0	Cottonwood	'36,'37,'38,40	984	351	55.55	64.2	Bismarck, N.D.	33	
	6	2R, 4R to 12R	7A	2-2 &3-2	Colo.blue spruce	'36,'37,'38,41	1255	383	50	61.0	Colorado	8	405
	5	16R,17R,21R,22R,23R	7B	1-0	Cottonwood	'36,'37,'38, 40	543	309	100	56.9	Bismarck, N.D.	29	
	3	18R, 19R, 20R	7B	2-2 and 3-2	Col.bl.spruce	'36,'37, 38,40,'41	421	301	100	71.5	Colorado	12	356&405
	8	116 to 123	9	2-1	J. scopulorum	1932	965	342	100	35.5	Bottineau Nurs.N.D.	16	
	4	51 to 54	6BB	2-2	J. scopulorum	1940	423	199	50	94.1	Medora, N.D.	16	361
	25	55 to 79	10A	2-2	J. scopulorum	1940	3391	1041	36	85.2	Butte Creek, Mont.	14	367
	11	80 to 90	10B	2-2	J. scopulorum	1940	1290	439	36.4	93.5	Black Hills,S.D.	13	375
	19	91 to 109	10B	2-2	J. scopulorum	1940	2101	701	36.85	90.6	Black Hills,S.D.	15	375

Denbigh plantation status on April 1, 1942 in NW of SW of Sec. 36

Location	No. rows	Assigned row No.	Planting No.	Age of stock	Species	Date planted and replanted	Total No. trees in plantation	Trees alive: fall 1941	Percent of count 1941	Survival fall 1941	Col. No.	Seed source	Average height fall 1941
									Percent				Inches
E½ NW SW (5)	16	1R to 16R	24B	2-0	Ponderosa pine	1936,1937	6804	530	25	31.2		Custer NF, Mont. Harney NF, S.D.	13
	20	1R to 20R	24C	1-0	Cottonwood	1936,1937 '38,'39,'40	2023	161	25	35.8		Bismarck, N. D.	26
	10	21R to 30R	24D	1-0	Cottonwood	1936,1937 '38,'39,'40	829	133	40	40.1		Bismarck, N. D.	21
	10	31R to 40R	24E	1-0	Cottonwood	1936,1937 '38, '39	958	63	30	21.9		Bismarck, N. D.	37
	20	41R to 60R	24F	1-0	Cottonwood	1936,1937 '38, '39	1621	122	25	23.1		Bismarck, N. D.	43
	6	61R, 63R to 71R	24G	1-0	Chinese elm	'36,'37,'38	511	148	50	57.9		Bottineau, N. D.	37
	6	62R, 64R to 70R	24G	2-0	Scotch pine	'36,'37,'38	470	35	60	12.4		Bismarck, N. D.	21
	11	72R, 73R, 74R, 76R and 78R to 84R	24HR	1-0	Cottonwood	'36,'38,'39	940	115	45.4	26.9		Bismarck, N. D.	35
	2	75R, 77R	24HR and 3-2	2-2	Ponderosa pine	1938,1941	402	124	100	30.8	363	Fallon, Mont.	5
	26	85R to 110R	24IR	1-0	Cottonwood	1936,1938	2201	113	23.1	22.3		Bismarck, N. D.	36
	12	111R to 122R	24J	2-1	Ponderosa pine	1936,1937	1139	184	33.33	37.9		Custer NF, Mont. Harney NF, S.D.	19
	18	123R to 140R	24K	2-1	Ponderosa pine	'36,'37,'38	1680	351	33.33	62.6		Harney NF, S.D.	12
	10	141R to 150R	24L	2-1	Ponderosa pine	1936,1937	927	125	40	33.7		Custer NF, Mont.	13
W½ NW SW (5)	23	1 to 23	26A	Large 2-0	Ponderosa pine	1935	5163	248	21.75	22.1		Harney NF, S.D.	14
	4	24 to 27	26A	Small 2-0	Ponderosa pine	1935	969	14	100	1.4		Harney NF, S.D.	12
	10	1 to 10	26E	3-1	Siberian larch	1940	1274 (6132)	79	30	20.7	383	Purchased from J. Rafn & Co.	8
	5	11 to 15	26F and 4-3	4-2	Douglas fir	1940,1941	960	294	60	51.1	377	Region 1, USFS	5
	5	16 to 20	26G and 3-4	3-3	Black Hills spruce	1940,1941	639	427	100	66.8	330	Black Hills, S.D.	10
	6	1R to 6R	27B	1-0	Cottonwood	1936,1937 1938,1940	712	141	50	39.6		Bismarck, N. D.	32
	2	21 and 22	27C	3-3	J. scopulorum	1940	200	134	100	67.0	355	Medora, N. D.	15
	4	23 to 26	27D	2-1	Jack pine	1940	400	5	50	2.4	372	Chippewa NF, Minn.	7
	4	27 to 30	27E	2-2	J. scopulorum	1940	386	169	60	87.5	361	Medora, N. D.	11
	13	7R to 19R	28A	1-0	Cottonwood	1936,1937, 1938,1940	1435	220	30.77	49.8		Bismarck, N. D.	34
	6	31 to 36	28B	2-2	J. scopulorum	1940	611	224	50	73.3	367	Medora, N. D.	11
	12	20R to 31R	31B	1-0	Cottonwood	1936,1937, 1938,1940	1382	135	33.33	29.3		Bismarck, N. D.	25
	12	32R to 43R	31C	1-0	Cottonwood	1936,1937, 1938,1940	1404	230	33.33	49.1		Bismarck, N.D.	34
	14	44R to 57R	31D	1-0	Cottonwood	1936,1937, 1938,1940	1735	300	28.6	60.5		Bismarck, N. D.	31
	2	58R, 59R	31E	2-0	Burr oak	'36,'37,'39	237	122	100	51.5		Pleasant Lake, N.D.	9
	4	61R to 64R	31E and 3-4	3-2	J. scopulorum	1939, 1941	563	227	50	80.6	317	Watford City, N.D.	12
	7	64R, 66R to 76R	31F	1-0	Chinese elm	'36,'37,'38	676	239	57.1	59.4		Shelterbelt Proj.	38
	6	65R, 67R to 75R	31F and 2-1	1-1	Ponderosa pine	'36,'37,'38	676	163	50	54.1 and 376	331	Harney NF, S.D.	12

Denbigh plantation status on April 1, 1942 in NE of SW of Sec. 36

Location	No. rows	Assigned row No.	Planta-tion No.	Age of stock	Species	Date planted and replanted	Total No. trees in plantation	Trees alive fall 1941	Percent of count 1941	Survival fall 1941	Col. No.	Seed source	Average height fall 1941
									Percent				Inches
NE SW	40	1 to 40	49	1-0	Green ash	'35,'37,'38	14,043	1430	20	50.9		Kenmare, N. D.	12
(6)	7	1 to 7	49	3-1	Ponderosa pine	1940	956	78	14.28	57.1	397	Custer, S. D.	4
	20	8 to 27	49	2-2	Ponderosa pine	1940	2,146	117	20	27.3	397	Custer, S. D.	6
	13	28 to 40	49	3-1	Ponderosa pine	1940	2,136	124	23.1	25.1	397	Custer, S. D.	5
	40	1 to 40	49		All above ponderosa	1940	5,238	317	20	30.3	397	Custer, S. D.	5
	34	41 to 74	50	1-0	Cottonwood	1935,1938	7,279	689	17.35	53.6		Bismarck, N. D.	46
	34	41 to 74	50	2-2	J. scopulorum	1940	3,482	441	17.35	34.3	367	Butte Creek, Mont.	12
	11	75 to 85	51A	1-0	Cottonwood	1938	2,042	222	36.4	29.9		Bismarck, N. D.	43
	11	75 to 85	51A	1-0	White elm	1935 Est.	3,405	56	27.27	6.0		Riga, N. D.	21
	5	86 to 91	51	1-0	White elm	1935 Est.	1,853	134	50	14.4		Riga, N. D.	16
	27	92 to 118	52 and 53	1-0 and 3-0	Green ash	1935,1938	9,154	1265	25.93	48.8		Kenmare, N. D.	17
	27	92 to 118	52 and 53	2-2 and 3-2	Ponderosa pine	1940,1941	4,042	404	25.93	38.5	397	Custer, S. D.	7
	10	119 to 128	53A	2-1	Ponderosa pine	1938	2,196	450	50	41.0		Harney NF, S.D.	10
	2	129 and 130	53A	3-0	Scotch pine	1938	652	10	100	1.5		Bottineau, N.D.	11
	5	131 to 135	54A	3-0	Green ash	1935,1938	2,022	646	60	53.8		Kenmare, N. D.	24
	5	131 to 135	54A	3-3	Black Hills spruce		581	266	60	76.3		Black Hills, S.D.	17

Denbigh plantation status on April 1, 1942 in W½ SW of ~~NW~~ SW of Sec. 36

Location	No. rows	Assigned row No.	Planta-tion No.	Age of stock	Species	Date planted and replanted	Total No. trees in planta-tion	Trees alive fall 1941	Percent of count 1941	Survival fall 1941	Col. No.	Seed source	Average height fall 1941
									Percent				Inches
W½ SW SW (7)	20	1 to 20	34A	2-2	Ponderosa pine	1939	3356	361	25	43.0	364	Glendive, Mont.	8
	5	21 to 25	35	1-1-1	Ponderosa pine	1934	882	256	100	29.0		Bitterroot For.,Mont.	15
	3	26 to 28	35	1-1-1	Ponderosa pine	1934	533	47	100	8.8		Bitterroot F.,Mont.	10
	2	29 and 30	35	1-1-1	Ponderosa pine	1934	335	22	100	0.9		Bitterroot F.,Mont.	13
	10	21 to 30	35	1-1-1	Ponderosa pine	1934	1750	325	100	18.6		Bitterroot F.,Mont.	13
	3	31 to 33	36	2-1	Scotch pine	1934	537	15	100	2.8	253	Tawas City, Mich.	13
	2	34 and 35	36	2-1	Scotch pine	1934	356	2	100	0.8	253	Tawas City, Mich.	15
	2	36 and 37	36	2-1	Scotch pine	1934	351	3	100	0.9	127	Authentic Riga	22
	1	38	36	2-1	Norway pine	1934	176	0	100	0.0	173		--
	3	39 to 41	37A	2-0	Jack pine	1935	533	24	100	4.5	302	Solway, Minn.	21
	2	42 and 43	37A	2-0	Jack pine	1935	349	9	100	2.6	302	Solway, Minn.	17
	6	44 to 49	37B	2-0	Jack pine	1935	1056	12	50	2.3	275	McPhid Ranch, Towner,N.D.	13
	4	50 to 53	38AR	1-1 and 2-2	Ponderosa pine	1935,1939	530	186	60	52.2	376	Harney NF, S.D.	8
	2	54 and 55	38BR	2-2	Ponderosa pine	1939	343	111	100	32.4	380	Western Nebr.	10
	5	56 to 60	38CR	3-2	Pinus leucosperma	1939	880	17	40	4.8	289	Kujo Chosen,Japan	8
	12	61 to 72	39	1-1	Ponderosa pine	1935	2128	85	33.33	12.0		Custer NF,Mont.	10
	4	73 to 76	40A	1-1	Ponderosa pine	1935	715	23	50	6.5		Bitterroot NF,Mont.	11
	6	77 to 82	40BR	2-2	Ponderosa pine	1939	1048	35	33.33	10.0	365	Jordan, Mont.	10
	8	83 to 90	41A	2-2	Ponderosa pine	1939	1286	74	37.5	15.4	380	Western Nebraska	7
	8	83 to 90	41A	3-0	Platte River juniper	1935	1416	57	37.5	10.7		Nebraska	17
	10	91 to 100	42AR	2-1	Jack pine	1938,1939	1789	101	30	20.7	372	Chippewa NF,Minn.	13
	10	91 to 100	42AR	1-0	Burr oak	1935	1778	8	30	0.9	320	Pleasant Lake,N.D.	9
	10	101 to 110	43ARA	2-1 and 2-2	Ponderosa pine	1938,1939	1799	207	30	38.4	363	Fallon, Mont.	7
	10	111 to 120	43ARB	2-1 and 3-2	J. scopulorum	1938,1939	1781	158	30	29.6	317	Watford City,N.D.	8
	10	121 to 130	43ARC	2-1	Scotch pine	1938	1782	4	20	1.1	331	Rochester,Minn.	10
	2	131 and 132	43BR	2-2	Scotch pine	1938	326	2	100	5.5	259A	Cochrane, Wis.	9
	6	133 to 138	67	3-4	Black Hills spruce	1941	1058	442	50	41.8	330	Black Hills,S.D.	Est.8
	2	139 and 140	68	4-2	Douglas fir	1941	357	87	100	24.5	377	Region 1, USFS	Est.8
	5	141 to 145	69	2-1	Ponderosa pine	1941	887	817	100	92.1	438	Fallon, Mont.	4
	5	146 to 150	69	2-1	Ponderosa pine	1941	935	813	100	87.0	438	Fallon, Mont.	5
	5	151 to 155	70	2-0	Ponderosa pine	1941	912	591	100	64.9	376	Black Hills, S.D.	4
	5	156 to 160	70	2-0	Ponderosa pine	1941	894	379	100	42.4	376	Black Hills, S.D.	4
	5	161 to 165	71	2-2	Ponderosa pine	1941	854	579	100	67.8	363	Fallon, Mont.	8
	5	166 to 170	71	2-2	Ponderosa pine	1941	863	464	100	53.8	363	Fallon, Mont.	8
	5	171 to 175	72	3-2	Ponderosa pine	1941	895	828	100	83.2	397	Custer, S.D.	8
	5	176 to 180	72	3-2	Ponderosa pine	1941	900	898	100	84.2	397	Custer, S.D.	8
	5	181 to 185	73	2-1	J. scopulorum	1941	903	897	100	99.2	403		7
	5	186 to 190	73	2-1	J. scopulorum	1941	884	837	100	94.7	403		7
	5	191 to 195	74	2-0	J. scopulorum	1941	905	868	100	95.9	437		5
	5	196 to 200	74	2-0	J. scopulorum	1941	883	695	100	78.7	437		8
	5	201 to 205	75	2-2	J. scopulorum	1941	884	863	100	97.6		Medora, N. D.	13
	5	206 to 210	75	2-2	J. scopulorum	1941	911	885	100	97.1		Medora, N. D.	13
	5	211 to 215	76		Scotch pine	1941	826	439	100	53.1	385		7
	5	216 to 220	76		Scotch pine	1941	841	335	100	39.8	385		8

Denbigh plantation status on April 1, 1942 in E½ SW SW Sec. 36

Location	No. rows	Assigned row No.	Plantation No.	Age of stock	Species	Date planted and replanted	Total No. trees in plantation	Trees alive fall 1941	Percent of count 1941	Survival fall 1941	Col. No.	Seed source	Average height fall 1941
										Percent			Inches
E½ SW SW	4	1 to 4	45	3-0	J. virginiana	1934	709	37	50	10.4		Platte River, Nebr.	18
(7)	4	1 to 4	45	2-2	Ponderosa pine	1939	643	114	50	35.5	380	Western Nebraska	13
	30	5 to 34	46	2-0	Green ash	1934	5272	32	16.67	3.6		Mandan, N. D.	9
	56	35 to 90	47A	1-0	Green ash	1935	9585	31	10.7	3.0	325	Kenmare, N. D.	7
	30	91 to 120	47B	Seed	Burr oak	1935	4686	0	10	0.0	360	Pleasant Lake, N.D.	-
	10	121 to 130	47BR	2-2	Ponderosa pine	1939	1782	44	50	8.2	364	Glendive, Mont.	8
	2	131 and 132	47CR	1-1	J. virginiana	1936	349	30	100	9.7		Nebraska	11
	2	131 and 132	47CR	2-2	Ponderosa pine	1939	310	55	100	15.8	380	Western Nebraska	13
	5	133 to 137	47DR	2-2	Jack pine	1939	866	31	40	8.9	372	Chippewa NF, Minn.	13
	47	138 to 184	47ER	2-2	Ponderosa pine	1939	8107	282	10.64	32.7	363	Fallon, Mont.	6
	2	185 and 186	47FR	2-4	J. scopulorum	1941	277	116	50	84.0	317	Watford City, N.D.	8
	14	187 to 200	47F	2-0	Scotch pine	1936	2436	2	21.43	1.1	336	Rochester, Minn.	18
	10	201 to 210	47GR	2-2	Ponderosa pine	1939	1166	30	30	8.6	364	Glendive, Mont.	7
	3	211 to 213	47HR	2-2	Ponderosa pine	1939	495	3	33.33	1.8	363	Fallon, Mont.	6
	3	214 to 216	47IR	2-2	Ponderosa pine	1939	485	11	33.33	6.8	364	Glendive, Mont.	7

Denbigh plantation status on April 1, 1942 in SE of SW of Sec. 36

Location	No. rows	Assigned row No.	Planta-tion No.	Age of stock	Species	Date planted and replanted	Total No. trees in planta-tion	Trees alive fall 1941	Percent of count 1941	Survival fall 1941	Col. No.	Seed source	Average height fall 1941
										Percent			Inches
W½ SE SW	4	1 to 4	55A	2-2-1	Ponderosa pine	1940	1169	151	50	22.4	365	Fallon, Mont.	6
(8)	1	5	55A	3-2	Ponderosa pine	1940	242	122	100	50.4	365	Fallon, Mont.	7
	4	6 to 9	55B	2-2-1	Ponderosa pine	1940	1201	238	50	39.3	364	Glendive, Mont.	6
	1	10	55B	3-2	Ponderosa pine	1940	310	207	100	66.8	364	Glendive, Mont.	7
	1	11	55B	2-2-1	Ponderosa pine	1940	312	Not counted in 1941			364	Glendive, Mont.	-
	3	12, 13, 14	55C	2-2-1	Ponderosa pine	1940	579	145	50	50.1	365	Jordan, Mont.	5
	2	15, 16	55C	3-2	Ponderosa pine	1940	578	122	50	42.2	365	Jordan, Mont.	8
	6	17 to 24	55D	2-1	Ponderosa pine	1940	1047	38	37.5	9.4	423	Black Hills NF, S.D.	5
	1	25	55E	2-2	Ponderosa pine	1940	296	288	60	32.5	380	Western Nebraska	6
	5	26 to 30	55E	2-2-1	Ponderosa pine	1940	1478	63	100	21.3	380	Western Nebraska	6
	4	31 to 34	55F and 55G	3-1 and 3-2	Ponderosa pine	1940,1941	1207	272	50	45.1	397	Custer, S. D.	6
	4	1 to 4	56	1-0	Cottonwood	'38,'39,'40	847	275	50	53.1		Bismarck, N.D.	55
	5	1 to 5	57	2-2	Ponderosa pine	1939	1595	27	40	4.2	380	Western Nebraska	5
	5	1 to 5	57A	2-2	Ponderosa pine	1939	1620	32	40	4.9	364	Glendive, Mont.	8
	5	1 to 5	57B	2-2	J. scopulorum	1940	1470	202	40	34.4	367	Butte Creek, Mont.	7
E½ SE SW	34	1 to 34	58	2-2	J. scopulorum	1940	9445	1317	20.6	67.8	375	Black Hills, S.D.	8
	6	35 to 40	58A	2-2	J. scopulorum	1940	1690	768	50	90.8	367	Butte Creek, Mont.	10
(8)	16	1 to 16	59	2-2	J. scopulorum	1940	4634	1275	31.25	88.1	367	Butte Creek, Mont.	9
	8	17 to 24	59A	3-1	J. scopulorum	1940	2252	600	37.5	71.1	367	Butte Creek, Mont.	9